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A STUDY OF THE CESTODE PARASITES OF THE BLACK BASS IN OHIO, WITH SPECIAL REFERENCE TO THEIR LIFE HISTORY AND DISTRIBUTION.

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INTRODUCTION

These studies were first undertaken by the writer in the early summer of 1921 at the Lake Laboratory of Ohio State University at Put-in-Bay, Lake Erie, at the suggestion of Dr. R. C. Osburn, who had become interested in the larval stages of a proteocephalid found in the intestinal tract of young small-mouth bass (*Micropterus dolomieu*) just off their nest. At this time they measured 13–15 mm. The finding of large numbers of plerocercoids at such an early stage gave a clue as to the possible life history. Two possibilities were offered: either a direct infection or an infection through an intermediate host.

The earlier studies on the food of the young bass by E. L. Wickliff ('20) and Turner and Kraatz ('20) had shown that definite food cycles were present. Examinations were made of hundreds of these young bass, studying especially the stomach contents to discover the origin of the plerocercoid.

The studies also included an examination of the life history of two other cestode species found in the bass, studies of distribution of cestode species and on the degree of parasitism of bass in the state. In addition to the material collected during the summers of 1921 and 1922 many adult and young large- and small-mouth bass were examined from various sections of the state.

The methods were those ordinarily used for cestodes. La Rue ('14) gives the methods used in his study of Proteocephalidae and in the main these were followed.

Life History of Proteocephalus pearsei La Rue 1919

(Figs. 1, 2, 4, 14, 20.)

The larval proteocephalids found in the young small-mouth bass proved to be *P. pearsei*. The hosts given by La Rue for this species are *Perca flavescens* and *Ambolplites rupestris*. A very close series was obtained from the plerocercus to the adult.

In 1921 the bass left their nests the second week in June. Early in the season eighty per cent of the fish were infested. The average number of larvae per fish ranged from 4 to 12 on different days. In 1922 the infestation was much heavier. Nearly all were infested and early in the season 15 to 30 larvae were found in a fish. Later the infestation was much lighter.

Hosts.—These cestodes were found in small-mouth bass (*Micropterus dolomieu*), large-mouth bass (*M. salmoides*), rock bass (*Ambloplites rupestris*), blue gill (*Lepomis pallidus*), perch (*Perca flavescens*), and white bass (*Roccus chrysops*). In nearly every case they were found in young fish.

But little is known concerning the life history of the Proteocephalids. La Rue ('14) reviews the data and says concerning the intermediate hosts of the Protocephalids, "From the data presented by various workers it seems probable that the life history of the Proteocephalids is as follows: The eggs and some of the ripe proglottids bearing eggs are voided by the host into the water where they are eaten by some invertebrate, perhaps a worm, an insect larva, or a crustacean or possibly the eater is a vertebrate, fish, snake or amphibian of the same species as the host or different. If the invertebrate or vertebrate furnishes a suitable habitat for the development of the parasite it develops a plerocercoid about which the host produces a cyst, etc."

The work of Janicki and Rosen ('17) and Rosen ('18) offers some very important contributions to the life history of cestodes. Their papers were not seen until these studies were completed. Rosen was successful in solving the life histories of three cestode species by experimental methods. After studies with many groups of invertebrates under carefully controlled conditions, Rosen obtained positive results. He infected *Cyclops strenuus* and *Diaptomus* with the eggs of *Dibothriocephalus latus L.* Rosen says, "Three months after infection the larvae are still

living and fixed to the external wall of the intestine." The next stage of these studies was the infection of the fish which are second intermediate hosts of *D. latus*. Young trout were fed cyclops and Diaptomus which had been infected six weeks previously. The activated procercoids penetrate the muscular wall of the stomach and migrate to the liver or muscular tissues where the plerocercoid develops.

P. pearsei offered a favorable form for a life history study. The infection is obtained early while the food is made up of from 80% to 90% copepods. There was no other parasitism in the young bass at the first appearance of the infection. The copepods comprising the early food of the young bass consisted of: *Epischura lacustris, Diaptomus sicilis, Cyclops leuckarti, Cyclops serrulatus, Cyclops albidus* and *Cyclops prasinus. Cladocerans* and *ostracods* furnish a small part of the early fish food. The bass cease to eat copepods shortly after they reach 40 mm. After this time no plerocercoid stages were found.

The studies in 1921 yielded no definite results as to determination of an intermediate host. Early in the summer of 1922 a plerocercus was found in the body cavity of a species of *Cyclops*. The plerocercus was in the posterior part of the body cavity and its slow movements could be seen through the body wall. Further search resulted in finding many of these infested copepods. These were secured both in tow and by a careful examination of the stomach contents of the young bass. July 4, 1922, 12 of these infested copepods were found in tow at Put-in-Bay. In the stomach contents of a 20 mm. bass taken the same day 2 plerocercoids were seen emerging from a partially digested cyclops. Others were found shortly after emergence. Later *Epishura lacustris* was also found carrying this plerocercoid in the body cavity. Three individuals of this species were found that were infected.

The plerocercoid escapes as the copepod is digested and then passes to the intestine, where growth is rapid. See Figs. 1, 4, 14, for the early stages of the plerocercoid. Fig. 14 was drawn from a copepod taken in tow and was the earliest stage seen. Fig. 4 is a drawing of a somewhat later stage taken from cyclops found in stomach contents.

P. pearsei matures quickly, as shown by the early appearance of adult individuals, June 27, 1921, in an 18 mm. bass and in 1922 is indicated by the following records: On June 23, in a

17 mm. small-mouth bass there was found an individual with 10 proglottids. This cestode measured 4.9 mm. The scolex and one of the posterior segments are shown in Fig. 20. June 26, an 8 mm. individual was found with the posterior proglottids mature. This was found in a 17 mm. small-mouth bass. There were 25 larval *P. pearsei* in the intestine of this bass. July 2 in a 26 mm. small-mouth an individual 3.6 mm. long was found, with a neck 1.3 mm. long and 15 proglottids, the last two showing uterine pouches partially filled with eggs.

This cestode seems to be of but little economic importance, as most of them are lost the first season. There is but little correlation between degree of infestation and size of the fish.

Other Species.

Proteocephalus fluviatilis, new species.

(Figs. 8, 11, 13, 16, 18, 21, 22.)

The collections of this species were made from *Micropterus dolomieu* taken from southern Ohio streams. Individuals of this species were found in half of the bass examined. In most cases the infestation was heavy. This was the only cestode species found in this bass.

Diagnosis: Characters of the genus, worms of medium length, up to 180 mm., segmentation not very evident except in ripe proglottids, little wrinkling or folding. Head small and not set off from neck; suckers set well forward, close together; breadth of head, average 1.79 mm., 2.00 mm. maximum; length of head, average .089, 1.00 maximum. Diameter of suckers, average .079 mm. Fifth sucker muscular, functional, average .040 mm., in diameter .032–.045 and about .030 mm. deep. Neck 7, 5, 9, 10, 12, 16 mm. long by .5–.75 broad. First proglottid broader than long; .040 to .060 mm. long by .56 to .98 wide. Mature proglottid broader than long; 1.50 x .22–1.32 x .37–1.12 x .42–.90 x .50 mm. Ripe proglottids broader than long to quadrate, .90 x .55–.93 x .62–.63 x .64 mm. Genital sinus irregularly alternating in anterior one-third to one-half proglottid. Testes—two layers filling the space anterior to the ovary and between the vitellaria. Number of testes 73–98; average 84. Maximum diameter .084 x .068 mm., average .062 mm. x .046 mm. Vas deferens forming a compact coil extending on a line with the cirrus to the center of the proglottid. Cirrus pouch .160–.172–.212 long by .052–.060–.068 broad, average .185 x .055. Ratio of length of cirrus pouch to breadth of proglottid 2:7 to 2:9. Ductus ejaculatorius, 2–3 coils in cirrus pouch. Length of cirrus when protruded .058 to .098 by .03 mm. wide. Vagina anterior and dorsal cirrus pouch in most cases, extending straight

almost to the mid-line. Sphincter vaginæ weak. Receptaculum seminis anterior to the ovary. Vitellaria compact, follicules extending to anterior part of ovary, thinner in area of cirrus and vagina, but usually not absent. Ovary bilobed, connected by an arched mid-piece, thin and elongate in early proglottids, lobes thick and made up of separate parts in mature proglottids. Uterus with 3, 5, or 7 lateral outpocketings on either side.

Habitat: Intestine of *Micropterus dolomieu.*

The studies are based on about 100 stained and mounted specimens. Serial sections were useful for a part of the descriptions.

A large number of the worms were immature. The maximum length for the worms is 14, 16, and 18 cm. The segmentation is not marked, however, it is quite evident in ripe proglottids swollen with eggs. The worms have few folds or wrinkles and a weak muscular development. This is quite evident in the larval forms. The maximum breadth is 1.35–1.60 and is the greatest in the region of the mature proglottids.

The head (Fig. 16) is short and narrow. It is not set off from the neck. The suckers are well forward and are close together. The head measures .160–.20 mm. broad at the posterior margin of the suckers. The four suckers are placed very close together with sufficient room for the small fifth sucker at the apex. The suckers are nearly circular, muscular, cupped, and are from .064 to .098 mm. in diameter. The fifth sucker appears to be functional. It has a shallow cup and possesses musculature quite similar to the large suckers. It measures from .032–.045 in diameter by .026 to .034 mm. deep.

The length of the neck, as determined by measurement to the first segmentation visible in the stained specimen is 7–16 mm The neck is narrow, .2–.50 mm. wide. It is difficult to tell just where the neck ends, as the primordia of the reproductive organs appear early and there is a gradual increase in the development toward the posterior segments. The development of the reproductive organs is slower than in the other forms studied by the writer.

The early mature proglottids are much broader than long. In specimen 42: 8–1–21, 106 mm. long, in the 160th proglottid the breadth is 1.07 mm. and length .234 mm. The lobes of the ovary are separate, thin and elongate, each lobe 0.28 mm. broad by .040 mm. long. The testes are well developed and number 86. The vagina and cirrus sac, cirrus and ducts are

well developed. The vagina is widened at the anterior end. Fig. 21 shows a proglottid at a later stage than here described. The measurements of the 240th proglottid in this specimen (42) are 88 mm. by .45 mm. This proglottid is more nearly mature. The ovarian lobes are much thicker, closer together, compact, but still the separate divisions of the lobes can be distinguished. There are 311 proglottids in the specimen mentioned. Near the posterior end the reproductive organs are pushed aside by the uterine pouches. These fill almost completely the space between the follicles.

Fig. 22 is a drawing of a mature segment showing the early formation of the uterine pouches and Fig. 18 shows the conditions of a ripe proglottid filled with eggs. The ripe proglottids are more quadrate, measuring 84 x 70, 95 x 70, 90 x 80 mm.

The posterior proglottid is triangular in outline, the two lobes of the ovary crowded near the point of the triangle.

The genital pore is marginal and situated from the anterior third to near the middle of the proglottid, opening on a slight papilla in mature proglottids. The cirrus is elongate, ovoid, broadest at the inner end. The cirrus is straight, measuring .060–.100 in length when extended. The ductus ejaculatorius is thrown into from 1 to 3 coils in the cirrus sac. The vas deferens extends as a dense mass of coils to the middle of the proglottid. In ripe proglottids the coils of the vas deferens and vagina are pushed together in a small area by the uterine pouches.

The testes lie in two layers and number from 74–98. They measure from .056 x .040 to .084 x .068 mm.

The vagina usually opens slightly dorsal to the cirrus pouch and is anterior to it. It does not cross the cirrus pouch. In a few cases the vagina is ventral to the cirrus pouch. This is in specimens that were flattened while killing and fixing and it is probable that pressure altered the relations. The sphincter vaginae is very weak. It is located near the vaginal opening. The vagina curves gently to the mid-line and passes to near the ovary where it is thrown into a number of coils, both anterior and posterior to the arch connecting the ovarian lobes. The seminal receptacle is present as a pouch-like enlargement of the vagina anterior to the ovarian lobes. It was found only in earlier mature segments. The vitelline ducts and the circular shell gland could be seen in certain proglottids.

The vitellaria are follicular, forming a close mass at the lateral portions of the segment. The vitellaria are only partially interrupted by the cirrus sac and vagina. The vitellaria are situated .110 mm. from the margin in mature segments.

The uterus has few lateral outpocketings of large size. Most of these pockets are nearly straight and press against the vitellaria. They number 3, 5, and 7. The embryo measures .012–.014 mm. The three membranes were not measured.

Larval Stages.

(Fig. 8.)

The life history of this species has not yet been determined. The studies were made too late in the autumn of 1922 to determine an intermediate host. Young bass contained large numbers of these larval cestodes. It has not been possible to study these bass in the Ohio River drainage early in the year. The first young bass examined measured from 40 to 55 mm. These were from Anderson's Fork, Clinton County, and were obtained August 1, 1922. They contained many larval cestodes in the intestine, resembling the forms in the adult bass from the same stream. August 30, 1922, five specimens of small bass were obtained from the Olentangy River, Franklin County. All these were heavily infested with the small larval cestodes. September 19, 1922, four young small-mouth bass measuring 57, 62, 71 and 77 mm. were studied. There were from 20–60 larval cestodes in each of these fish. These cestodes formed a tangled mass in the intestine and occupied a larger mass than the digested food. See Fig. 8 for drawings of the scolex of these larval cestodes. Their musculature was weak. Their movements were slow and they broke apart easily.

Proteocephalus osburni, new species.

(Figs. 3, 15, 17, 19.)

This description is based on a single immature individual secured from a 57 mm. small-mouth bass taken by Dr. R. C. Osburn at the Akron Hatchery, August 28, 1922. There are so many characteristic differences and the structures are so definite that this individual is described as a new species. It is hoped that more material can be secured and a more adequate description given.

Diagnosis: Characters of the genus, size small, specimen immature, measuring 19 mm.; scolex (Figs. 3, 15) .140 broad by .060 mm. long; suckers deeply cupped, set well forward on the head. They measure .050 mm. in diameter. The fifth sucker is at the apex of the scolex and is .028 in diameter by .024 mm. deep. The neck is very long, 14 mm. to first trace of segmentation. The neck is .50–.60 mm. broad. There are but seven proglottids in this individual. The first measures .22 mm. long by .80 mm. broad, showing an abrupt widening from the neck. The next proglottid, (Fig. 19), shows well formed testes in a single layer. This proglottid measures .50 mm. in length and 1.00 mm. in breadth. The fourth proglottid shows the first indication of development of uterine pouches and measures .80 mm. in length by 1.25 mm. in breadth, (See Fig. 17). The seventh or end proglottid measures 1.10 mm. in length by .92 mm. in breadth. It is rounded at the posterior end.

The genital sinus is lateral and situated two-fifths to one-half the length of the proglottid from the anterior end. There is a genital papilla which is much more marked than in the case of *P. fluviatilis.* The vagina opens anterior to the cirrus. There is no evidence of a sphincter vaginae. The vagina is larger in diameter than in *P. pearsei.* The diameter is not constant. Near the vaginal opening the diameter is .016 to .020 mm.; the central portion near the inner end of the cirrus sac measures .007–.010 mm. Just anterior to the ovarian lobes the vagina is thrown into a loose coiled mass. This occupies a larger space than the coils in *P. fluviatilis.* The measurement of the vagina here is .016–.024 mm. and posterior to the straight connection of the ovarian lobes there are more coils of the vagina. The vaginal walls thicken and the diameter here is from .024 to .040 mm. No trace of a seminal recepticle was found.

The cirrus sac is V-shaped, the broadest part being near the genital opening. The cirrus sac is much larger than in *P. fluviatilis* and *P. pearsei.* It measures .320 x .112 mm.; .280 x .100 mm.; .360 x .80 mm. and .320 x .072 mm. in four proglottids. Both the cirrus and ductus ejaculatorius are coiled inside the cirrus sac, the latter being thrown into two to four loose coils. The cirrus is about twice the diameter of the ductus ejaculatorius. The extended cirrus was not seen. The vas deferens forms a narrow coiled portion extending to the center of the segment. The coiled portion is thicker at the center of the segment. The coils are loose and less in number than the other forms referred to by the writer.

The testes are in a single layer, closely pressed together between the vitellaria. They number from 50–60. They are modified by being pressed together. The average measurement is .068 x .052 mm. They vary from round to long ovoid form. The vitellaria are fine, densely packed and more numerous just anterior to the ovary. The vagina and cirrus sac completely interrupt the vitellaria.

The ovarian lobes are large, thick, heavy and irregular in outline and fill the posterior part of the segment except for a small area between the lobes. The mid-piece connecting the lobes is not arched in fully

mature segments. The lobes measure .310 mm. in maximum length and .468 mm. in maximum breadth.

The uterine pouches are formed in the fourth segment. They are small, straight and overlap. The counts of uterine pouches are 11–9, 10–8, 9–5, to 10–7, the lower number of pouches being on the side of the genital ducts. These pouches reach to the vitellaria in many cases.

Proteocephalus ambloplitis (Leidy).

(Figs. 5, 6, 7, 9, 10, 12.)

This species was found in the adult bass of Lake Erie. Twenty-five of sixty adult small-mouth bass taken within a few miles of Put-in-Bay were found infested. They had from 1–8 cestodes, the scolex usually fastened to the inside wall of the pyloric caeca and the strobila reaching into the intestine.

The larvae of this species are very abundant in many young fish. The larval cysts were found in very young fish attached to the mesenteries and in the visceral organs. They were often found in long thin-walled cysts confined to the peripheral portion of the liver. The worms show a slight activity within the cyst. The amount of infestation was not large in the young small-mouth bass. There was a much larger degree of infestation in the young large-mouth bass. Occasionally the liver and spleen were completely riddled by these parasites. In a few cases these plerocercoids were found inside the phyloric caeca.

Almost the same degree of infestation is found in the adult bass. In this case the cestodes were larger, often coiled about in the liver, reaching a length of 4–6 cm. No sexually mature individuals of *P. ambloplitis* were found during the first year's growth of bass.

The external and histological features of these plerocercoids have been well described by Cooper ('15). Cooper's data give records for 9 adult *M. dolomieu*. The present studies cover the examination of a large number of young large- and small-mouth bass. Several very early stages were found. The smallest of these plerocercoids were found in the mesenteries. Some specimens measured .16–.25 mm. in length, (see Figs. 5, 6). Some of these smaller forms were found imbedded in the muscular wall of the intestine of a large-mouth bass 26 mm. long. These young stages show the invaginated scolex in the process of formation. (Figs. 5, 6, 9, 10, 12). The four suckers seem to develop in the angles of a common area. The fifth sucker is the earliest to form, but remains vestigial.

Cooper ('15) failed to find an intermediate host for this form, but says concerning the life history, "Thus the evidence points to *P. ambloplitis* having at least two intermediate hosts, the first in some unknown species of arthropod, and the second either a different species of minnow, small perch or final host itself." My studies include the examination of younger bass than those of Cooper and offer additional evidence that this suggested life history is probably a correct one.

However, the plerocercus must reach the bass at a very early stage, soon after the bass come off the nest. The earliest forms found in the mesenteries are quite small and appear early in the life of the fish. These plerocerci must be carried by some of the copepods as the small-mouth bass scarcely ever eat amphipods. Also the liver and mesentery cysts are found in both large and small-mouth bass before they take amphipods. It must be an entomostracan and probably a copepod common in the diet of the bass at Put-in-Bay and the large-mouth bass along the harbors of the Ohio mainland. The young large-mouth bass show the heaviest infection. In these fish taken from West Harbor there were often 25–40 mesentery cysts and 6–10 liver cysts in a young fish measuring 25–37 mm. These young fish furnish the second intermediate host and development progresses rapidly. At this stage development is seen especially in the increase in size, muscular formation and in the further development of nervous and excretory systems.

In *Hyalella knickerbockeri* Bate, taken in tow at Put-in-Bay Harbor, encysted plerocerci were found. They were too large for *P. pearsei* plerocercoids, (see Fig. 7). In 12 *Hyalella* examined, 6 were infested with one or two of these plerocerci. These may be the plerocerci of *P. ambloplitis*. *Hyalella* is scarce at Put-in-Bay and not an important portion of the diet of the bass. At East and West Harbors several hundred of these amphipods were examined, but no plerocerci were found. If *Hyalella* is an invertebrate host for *P. ambloplitis*, there must also be another form, as these amphipods are too scarce to account for the degree of infestation and often young bass have the cysts before *Hyalella* is an article of diet.

Distribution of Cestodes.

La Rue ('14) gives a summary of hosts reported and localities for the *proteocephalidae* in amphibians, reptiles, and fish. *P. ambloplitis* is the only form reported for the bass. *P. ambloplitis* is known only from waters which drain into the St. Lawrence and Red River of the North, according to La Rue.

Prof. H. B. Ward (La Rue '14), examined the proper host species in the Illinois river, but the cestode was not found.

It was not found as adult in any of the 200 adult small-mouth bass examined from the Olentangy River, Little Miami River, Caesar's Creek, Paint Creek and other streams of the Ohio River drainage. In adult large and small-mouth bass examined from Newtown, London and Akron State Hatcheries, no adult *P. ambloplitis* were found. In a few cases larval cestodes of this species were found encysted in the livers. The probability is that these were in bass introduced from Lake Erie. This was known to be the case for those examined at one of the hatcheries. It seems likely that this cestode would be introduced in streams where adult bass from Lake Erie had been placed, but perhaps the proper invertebrate host is not present. The only record for finding the adult *P. ambloplitis* in the Ohio River drainage was at Lake Chautauqua, N. Y., where two adult bass had a heavy infestation. Many others showed only larval cysts in the viscera.

Proteocephalus fluviatilis.

This cestode was found only in *M. dolomieu* in southern Ohio streams. No other hosts were found for this species.

Proteocephalus pearsei.

This form was confined to the younger fish in Lake Erie and the Lake drainage. In a few cases this cestode was found in older fish. None were found in the Ohio River drainage.

Proteocephalus exiguus.

This form was not found in Ohio, but was found in *M. dolomieu* in material collected by Needham and Sibly, at Lake George, N. Y.

Pseudophyllidean Cestodes.

Cooper ('18) revised the family describing the forms belonging to this group and including several new species from North American fish. Two species of larval cestodes belonging to this group were found in small-mouth bass. They were found only in a few cases and perhaps represent chance infestation.

Triaenophorus nodulosus (Pallas).

Two specimens of this species were discovered both encysted in the liver. They were coiled in an oval cyst near the periphery of the organ. One was found in a young small-mouth bass and the other in an adult of 27 cm.

Bothriocephalus claviceps (Goeze 1784).

Adult specimens of this cestode were found in the upper intestine of a rock bass (*Ambloplitis rupestris*). Larval forms were found in four small-mouth bass; two from 10 cm. individuals secured near Put-in-Bay, one from an 11 cm. small-mouth from Maumee Bay, and one from an adult small-mouth taken from Anderson's Creek, Clinton County, Ohio.

Summary.

1. The studies include examination of a large number of adult and young specimens of large and small-mouth bass from many sections of Ohio and from Lake Erie. In the small-mouth bass seven species of cestodes were found. Two of these were new species and six had not been previously reported for the bass. In large-mouth bass two species of cestodes were found.

2. By intensive study of young bass from the time they leave their nests it is shown that certain cestodes are obtained early, while the food is chiefly copepods.

3. The factors involved in a life history study are date of infection, age of fish, and food of fish at the time.

4. The life history of one proteocephalid (*P. pearsei*) was demonstrated. The intermediate host may be either of two species of copepods, *Epishura lacustrius* or a small species of *Cyclops*.

5. The studies on the early larval stages of *P. fluviatilis* indicatea life history similar to *P. pearsei.*

6. Evidence points to two intermediate hosts for *P. ambloplitis;* one an *Entomostracan* and the other a minnow or young fish of the same species as the host of the adult *P. ambloplitis.*

7. There are different cestode parasites in the bass in Lake Erie and its drainage system from those in the Ohio River drainage.

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EXPLANATION OF FIGURES.

Plate I.

All drawings have been with the aid of the camera lucida and the scale given with each.

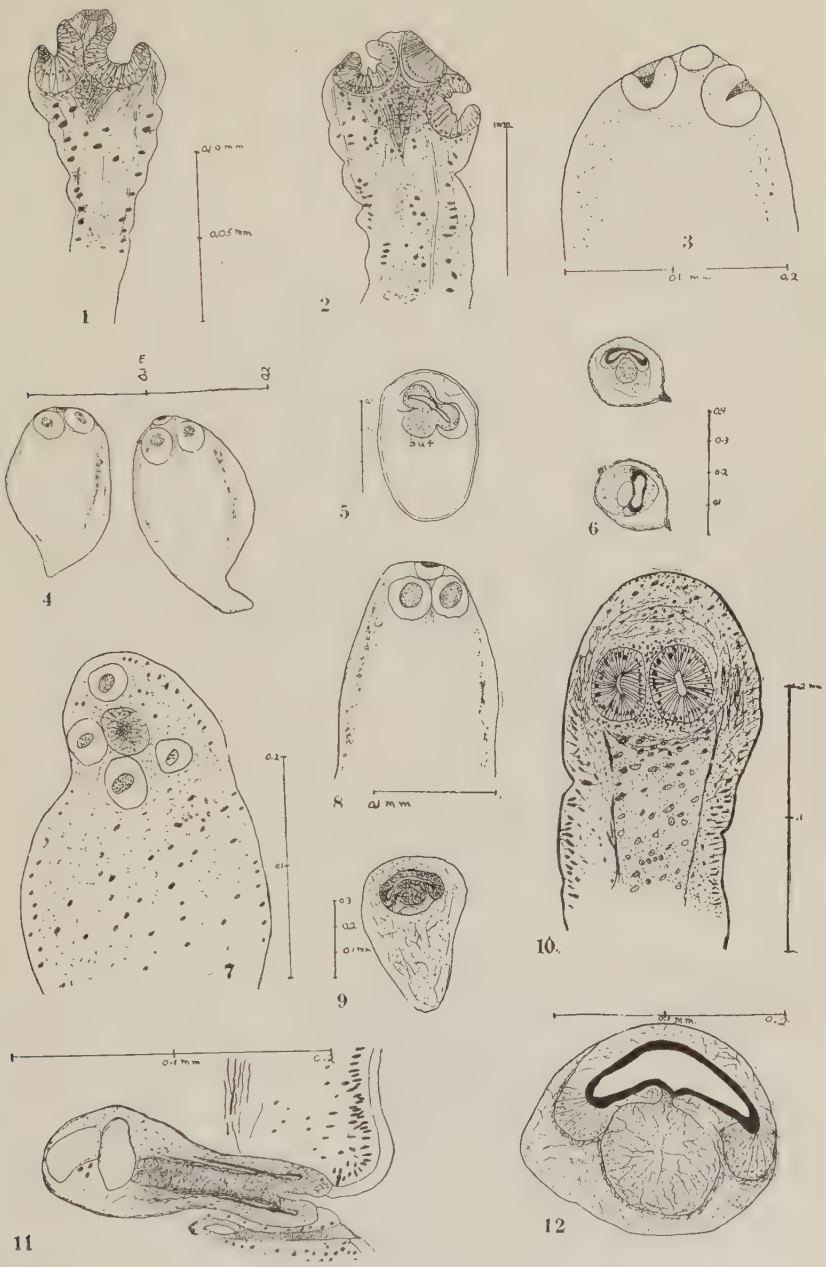
Abbreviations used:

Ci—Cirrus.
Mf.—Muscle fibers.
Ov—Ovary.
Sg.—Shell gland.
Sr.—Receptaculum seminis.
Suf.—Fifth Sucker.
T—Testes.
Utl.—Lateral uterine pouches.
Va.—Vagina.
Vas—Sphincter vaginae.
Vd—Vas deferens.
Vi—Vitellaria.

Fig. 1. Proteoce.halus pearsei, head of larva, longitudinal section showing structure of suckers, etc.
Fig. 2. Proteocephalus pearsei, head of adult, longitudinal section.
Fig. 3. Proteocephalus osburni, head, one of four suckers shown by dotted line ventral, not indicated, adult, type specimen.
Fig. 4. Proteocephalus pearsei, larvae, the smaller taken from cyclops, the other from the stomach contents of 15 mm. small-mouth bass, 6-20-22.
Fig. 5. Proteocephalus ambloplitis, plerocercoid from the liver cyst showing formation of suckers.
Fig. 6. Proteocephalus ambloplitis, early plerocercoids from mesentery cysts.
Fig. 7. Plerocercoid taken from body cavity of Hyalella knickerbockeri.
Fig. 8. Proteocephalus fluviatilis, head toto, larval.
Fig. 9. Proteocephalus ambloplitis, plerocoid from mesentery cyst.
Fig. 10. Proteocephalus ambloplitis, longitudinal section of plerocercoid from intestine of young large-mouth bass to show details of suckers etc., section not through center of plerocercus.
Fig. 11. Proteocephalus fluviatilis, cirrus, cirrus pouch, and portion of vagina. Note.—The vagina is dorsal to the cirrus sac. This drawing is inverted.
Fig. 12. Proteocephalus ambloplitis, portion to show details of developing suckers and vestigial fifth sucker of plerocercus.

Plate II.

Fig. 13. Proteocephalus fluviatilis. Section showing cirrus, portions of vagina and ovarian lobes.
Fig. 14. Cyclops prasinus with plerocercus in body cavity, appendages removed from cyclops.
Fig. 15. Proteocephalus osburni, head, toto.
Fig. 16. Proteocephalus fluviatilis; head, adult toto.
Fig. 17. Proteocephalus osburni, ripe prolgottid, toto.
Fig. 18. Proteocephalus fluviatilis, ripe proglottid toto showing filled uterine pouches, type specimen.
Fig. 19. Proteocephalus osburni, early mature proglottid toto.
Fig. 20. Proteocephalus pearsei, early mature individual from 17mm. small-mouth bass collected 6–22–22.
Fig. 21. Proteocephalus fluviatilis, toto early mature proglottid showing testes and relations of cirrus and vagina.
Fig. 22. Proteocephalus fluviatilis late mature proglottid showing formation of lateral uterine pouches and more typical vagina than in preceding stage.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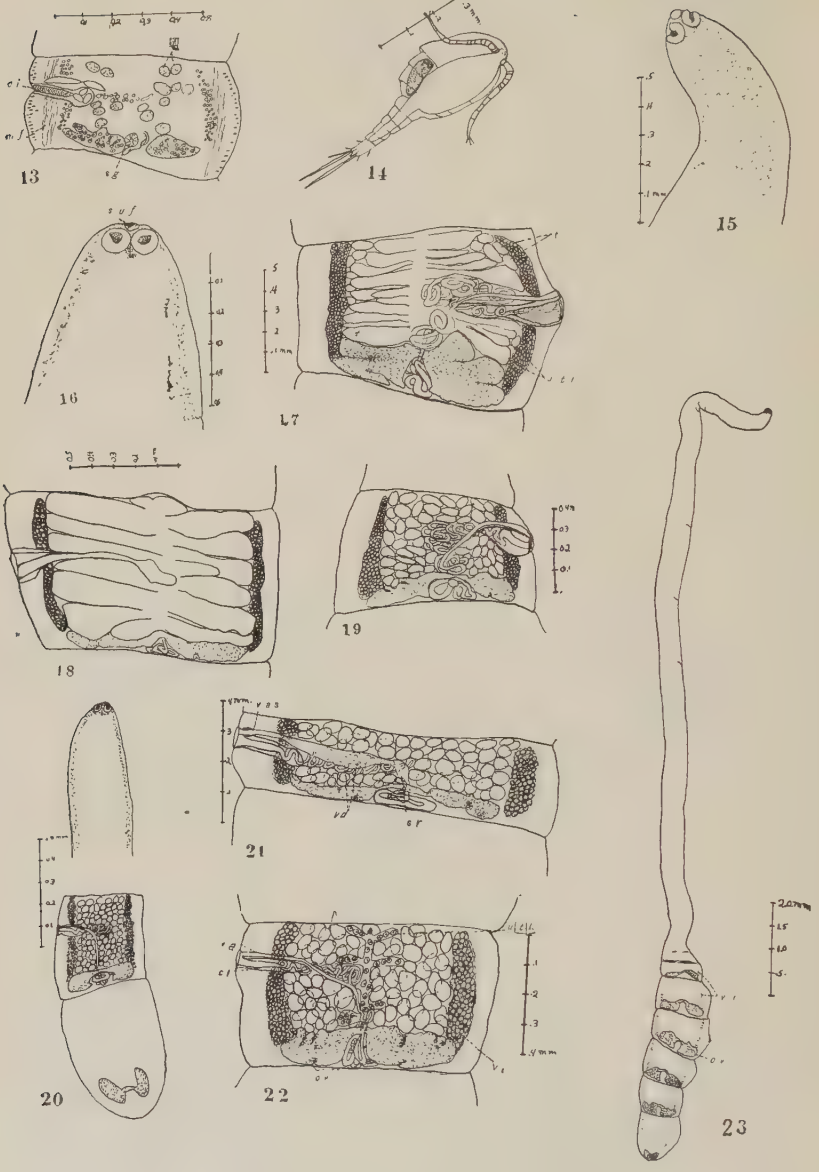
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THE CARROT FAMILY IN OHIO.*

NELLIE F. HENDERSON.

Ammiaceae, Carrot Family.

Herbs with alternate, simple or compound, frequently dissected leaves, often with sheathing or dilated petioles, and solid or hollow often grooved stems. Inflorescence a simple or compound umbel with or without involucre and involucels, rarely a head, usually with numerous flowers. Flowers small, commonly white, yellow, or greenish, or occasionally of other colors; usually bisporangiate, epigynous, tetracyclic, choripetalous, actinomorphic, or the marginal ones slightly zygomorphic; andrecium, calyx and corolla pentamerous, the calyx commonly minute or suppressed; gynecium of two carpels. Ovulary bilocular, styles two, filiform, distinct, straight or recurved after flowering, often borne on a conic or depressed stylopodium; ovules one in each cavity, pendulous, anatropous, with a single integument. Ripe fruit a dry schizocarp, often flattened dorsally or laterally, splitting into the two-seeded carpels (mericarps) and usually supported on the summit of a slender axis (carpophore). Carpels or mericarps each with 5 primary ribs in their pericarps or rarely ribless, and in some genera with 4 additional secondary ones, the ribs of some of them often winged. Pericarp membraneous or corky thickened, usually containing oil-tubes under or between the ribs and on the commisural sides, sometimes irregularly scattered, and sometimes none.

Phyletic Synopsis.

I. Mericarps with woody fibrous endocarp without a carpophore.
(Hydrocotylatae) (Hydrocotylae) Hydrocotyle.

II. Mericarps with a soft parenchymatous endocarp; exocarp seldom smooth; style long with a capital stigma, surrounded at the base by a ring-like stylopodium; oil-tubes various. (Saniculatae) (Saniculeae).
- A. Fruit ribless, flowers scaly, densely capitate.
Eryngium.
- B. Fruit ribless, flowers not scaly, ours having fruit with dense prickles; umblets globose.
Sanicula.

III. Mericarps with soft parenchymatous endocarp, occasionally hardened by a sub-epidermal layer into a nut-like fruit. Style at the summit of the stylopodium. Oil-tubes developed laterally in the young fruit, later variously developed. (Ammiatae).
- A. Fruit with secondary ribs most prominent, winged or barbed with prickles, ribs slender and bristly. (Dauceae). Daucus, Torilis.
- B. Fruit with primary ribs only. Fruit linear or linear-oblong, several times longer than wide. (Scandicineae) Deringa, Chaerophyllum, Washingtonia, Scandix.

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* Papers from the Department of Botany, the Ohio State University, No. 161.

C. Fruit with primary ribs only, fruit oblong to ovoid or globose, not more than twice as long as wide. (Ammieae).
1. Fruit nearly terete.
a. Flowers yellow.
Thaspium.
b. Flowers white.
Ligusticum, Coriandrum, Aethusa.
2. Fruit flattened dorsally.
a. Flowers yellow.
Pastinaca, Anethum.
b. Flowers white.
Heracleum, Angelica, Conoselinum, Oxypolis.
3. Fruit flattened laterally.
a. Flowers yellow.
Zizia, Taenida, Apium, Foeniculum, Bupleurum.
b. Flowers white.
Sium, Aegopodium, Pimpinella, Cicuta, Conium, Eulopus, Carum, Celeri, Erigenia.

KEY TO THE GENERA.

1. All leaves simple....2
1. Some or all leaves compound or dissected....3
2. Leaves linear, toothed; flowers white or pink in a head....*Eryngium* (2)
2. Leaves orbicular, perfoliate; flowers yellow....*Bupleurum* (24)
2. Leaves reniform or orbicular, crenate; flowers white....*Hydrocotyle* (1)
3. Umblets globose; fruit with hooked bristles....*Sanicula* (3)
3. Umblets flat, or somewhat flat, or convex; fruit bristly or smooth....4
4. Leaves once compounded; flowers white....5
4. Leaves decompound, flowers white or yellow; or once compounded with flowers yellow....8
5. Leaves trifoliate....6
5. Leaves pinnately compound....7
6. No involucels, irregular loose umbels....*Deringa* (6)
6. Numerous linear bracts in involucels; 5–20 umblets in umbel rays stout. *Heracleum* (16)
7. Leaflets lanceolate, serrate; basal and lower leaves pinnatifid....*Sium* (26)
7. Leaflets lanceolate or entire, or with very few teeth in our species.... *Oxypolis* (19)
8. Flowers yellow or occasionally dark purple....9
8. Flowers white, greenish-white or pinkish....15
9. Leaf segments linear....10
9. Leaf segments broad, lanceolate to ovate or broader....11
10. Pedicels ⅛ in. or less long, fruit terete or nearly so....*Foeniculum* (23)
10. Pedicels ⅛–⅜ in. long, fruit flattened dorsally....*Anethum* (15)
11. Leaflets ovate, entire....*Taenida* (21)
11. Leaflets serrate, crenate, or incised....12
12. Stem leaves pinnately compound, large, leaflets broad, doubly cleft or serrate; stem prominently grooved....*Pastinaca* (14)
12. Stem leaves ternate, basal leaves simple or compound....13
13. Uppermost leaves linear-oblong, entire; involucre of 2–4 linear bracts.... *Apium* (22)
13. None of the leaves linear-oblong, involucre none or of small bracts....14
14. All of the flowers pediceled; fruit nearly terete....*Thaspium* (10)
14. Central flower of each umblet sessile; fruit flattened laterally....*Zizia* (20)
15. Low or slender decumbent, nearly acaulescent; leaves finely divided; umbels of 1–6 umblets....16
15. Tall and erect; embels of usually more than 6 many-flowered umblets....18
16. Scapose, subtending leaf involucrate to umbel; umbel of 1–4 umblets.... *Erigenia* (33)
16. Branched, involucre wanting or of few small bracts....17

17. Bracts of involucre notched at tip; fruit linear, flattened.....*Scandix* (9)
17. Bracts of involucre ovate-lanceolate; carpels 5-angled...*Chærophyllum* (7)
18. Involucre leafy; umbel 2–4 in. broad, concave in fruit, central flower often purple, ovulary bristly.....*Daucus* (4)
18. Involucre inconspicuous or none.....19
19. Leaf segments ovate or ovate-lanceolate, serrate or incised.....20
19. Leaves finely dissected into linear or narrow segments.....25
20. Umbels loose, 1–7 umblets; leaflets cut and deeply incised.....21
20. Umbels dense, umblets more than 7, usually numerous.....22
21. Unvolucels persistent, umbels very loose, peduncles long...*Washingtonia* (8)
21. Involucres and involucels small or none; umbels compact, opposite leaves. *Celeri* (32)
22. Involucels of numerous bracts.....23
22. Involucels of several small bracts or wanting.....24
23. Calyx-teeth acute; purple lines on stem; aquatic.....*Cicuta* (29)
23. Calyx-teeth obsolete; stem leaves nearly sessile; not aquatic..*Ligusticum* (11)
24. Stylopodium depressed; divisions of the leaves pinnate, upper leaves reduced with large sheathing bases.....*Angelica* (17)
24. Stylopodium conic; leaves ternate or biternate, ultimate segments stalked.....*Aegopodium* (27)
25. Few long linear leaflets; aquatic plants.....*Cicuta* (29)
25. Stem leaves dissected into many filiform divisions; plants not aquatic.....26
26. No involucre; basal leaves ovate or orbicular, incised, pinnate leaves.....27
26. Involucres present but may be early deciduous; all leaves divided into linear segments.....28
27. Involucels of few narrow bracts, deciduous; basal leaf segments deeply incised.....*Coriandrum* (12)
27. No involucels; basal leaf segments ovate, dentate.....*Pimpinella* (29)
28. Pubescent; ovulary with dense bristles.....*Torilis* (5)
28. Glabrous; ovulary smooth.....29
29. Bracts of involucels setaceous, turned downward to one side; stylopodium broad and thick.....*Aethuso* (13)
29. Bracts of involucels when present not turned to one side; stylopodium none, conic or depressed.....30
30. Calyx-teeth prominent; leaves ternately compound, segments linear..... *Eulophus* (30)
30. Calyx-teeth minute or obsolete.....31
31. Calyx-teeth minute; leaflets pinnatisected into linear filiform segments.. *Carum* (31)
31. Calyx-teeth obsolete; leaves ternate or broad, segments not filiform.....32
32. Wavy-ribbed; involucres and involucels of ovate-acuminate bracts; carpels nearly terete.....*Conium* (25)
32. Ribs of carpels not wavy; involucre none or of few short bracts; involucels of narrow acuminate bracts; fruit flattened dorsally.....*Conioselium* (18)

Description of Species.

1. *Hydrocótyle* L.

Prostrate herbs commonly rooting at the nodes. Leaves simple, palmately veined. Bracts of the involucre few or none. Flowers white. Calyx-teeth minute or obsolete. Fruit laterally compressed broader than long, no oil-tubes, but having a layer of oil-bearing tissue beneath the epidermis.

1. Leaves orvicular, peltate; pedicels slender.....*H. umbellata*
1. Leaves orbicular or reniform, not peltate.....2
2. Flowers umbellate, umbels nearly sessile.....*H. americana*
2. Umbels capitate, peduncled.....*H. rotundifolia*

1. *Hydrocotyle umbellàta* L. Many-flowered Marsh-Pennywort.

Perennial with glabrous creeping stem, subterranean branches tuberous; leaves simple, orbicular, crenate, peltate, petioles slender, 1-6 in. long; umbels long-peduncled, usually simple, pedicels slender; fruit strongly notched. In swamps and low ground. June-September. Portage and Stark counties.

2. *Hydrocotyle americàna* L. American Marsh-Pennywort.

Stems slender, creeping, propagating by stolons; leaves thin, reniform, crenate, not peltate, petioles short, seldom over 2 in. long; umbels nearly sessile, axillary, 1 to 5-flowered. In wet soil, June-September. Cuyahoga, Summit, Wayne, Stark.

3. *Hydrocotyle rotundifòlia* Roxb. Asiatic Penny-Wort.

Slender, tufted, creeping perennial; leaves reniform-orbicular; petioles slender; peduncles nearly as long as the petioles. Escaped to lawns from green-houses. Native of Asia. Summer. No specimens.

2. *Eryngium* (Tourn.) L.

Perennial herbs with spiny toothed leaves, lobed, dentate or entire; white or blue flowers in a head subtended by bracts; calyx-teeth rigid, acute, pungent; petals erect; disk expanded; fruit scaly or rough, somewhat flattened laterally, ribs nearly obsolete, oil-tubes, 5.

1. *Eryngium aquàticum* L. Button Snakeroot.

Stout glabrous perennial, 2 to 6 ft. tall; leaves mostly clasping, parallel veined, margins with bristly teeth, lower ones sometimes 3 ft. by 1½ in., upper ones smaller; heads globose-ovoid. By ponds and streams. June-September. Wyandot, Erie.

3. *Sanícula* L.

Perennial or biennial herbs with palmately 3 to 7-divided leaves, and globose umblets of small flowers; stems glabrous; umbels of few umblets; calyx-lobes usually persistent; petals obovate, inflexed; disk flat; carpels not ribbed; oil-tubes usually 5; fruit sub-globose with hooked bristles.

1. Petals and anthers yellow, calyx-lobes ovate, obtuse.....*S. gregaria*
1. Petals white.....2
2. Petals much longer than the obtuse, ovate calyx-lobes.....*S. marylandica*
2. Petals somewhat shorter than the linear-lanceolate, acute calyx-lobes.... *S. canadensis*
2. Petals about half as long as the linear, rigid, in-curved calyx-lobes..*S. trifoliata*

1. *Sanicula gregària* Bickn. Clustered Snakeroot.

Rather weak slender stemmed perennials with stems usually clustered and umbellate branched, 1 to 3 ft. high; leaves thin, light green, 5-foliate, segments stalked, obovate, acuminate, sharply serrate with bristle tipped teeth, involucral leaves foliaceous; some staminate flowers in separate heads, petals yellowish, much longer than the calyx-lobes, anthers yellow; fruit with weak bristles and long, persistent, recurved styles. Rich woods. May-July. Rather general.

2. *Sanicula marylándica* L. Black Snakeroot.

Glabrous perennials, 1½ to 2 ft. high, topped by 2 to 4-rayed, long-peduncled, compound umbel; leaves few, those near the base long-petioled, upper ones nearly sessile, bluish-green, 5 to 7-parted, irregularly serrate or incised; involucral leaves 3-parted, much smaller; staminate flowers often in separate heads, petals greenish-white, little longer than the calyx-lobes, anthers white; fruit sessile, covered by stout bristles, the long recurved styles persistent. In rich woods. May-August. General.

3. *Sanicula canadénsis* L. Short-styled Snakeroot.

Widely branched biennial, 1 to 4 ft. high, leafy, branches forked; all leaves petioled, 3 to 5-divided, segments to 3½ in. long, dull green, involucral leaves small, involucels bract-like; staminate flowers few, never in separate heads, petals white, shorter than the calyx-lobes; fruit nearly sessile, sub-globose, styles shorter than the bristles. In dry woods. May-August. General and abundant.

4. *Sanicula trifoliàta* Bickn. Large-fruited Snakeroot.

Slender, alternate-branched biennial, 1 to 2½ ft. tall; leaves thin, bright green, slender-petioled, 3-parted, lateral segments often cleft, segments stalked, broadly ovate, coarsely doubly serrate; petals white, about half as long as the calyx-lobes; fruit ovoid, styles shorter than the bristles. Rich hilly woods. June-August. Southern and eastern part of the state to Geauga, Morrow and Preble Counties.

4. *Daùcus* (Tourn.) L.

Involucre foliaceous, pinnately parted; involucels of numerous bracts; calyx-teeth obsolete; umblets many-flowered; ribs slender; petals obovate, inflexed at the tip, those of the outer flowers often 2-lobed; oil-tubes solitary under the secondary ribs.

1. *Daucus caròta* L. Queen Anne's Lace.

Bristly-stemmed biennial, 1 to 3 ft. tall, from a fleshy conic root; leaves 2 to 3-pinnate, segments lanceolate, pennatifid, the upper ones similar, but smaller; umbels 2 to 4 in. broad, very concave in fruit; flowers white, central one often purple; fruit bristly on wings. A common weed in waste places, pastures, and roadsides. The origin of the cultivated carrot and the only one of the family which is regarded for its beauty. Naturalized from Europe. June-September. General and abundant.

5. *Tórilis* Adans.

Involucre of few bracts or wanting; involucels of several narrow bracts; calyx-teeth triangular, persistent; petals inflexed at tip; stylopodium thick, conic; fruit flattened laterally, bristly.

1. Umbels sessile or short stalked.....*T. nodosa*
1. Umbels long-peduncled, compound.....*T. anthriscus*

1. *Torilis nodòsa* (L.) Gaertn. Knotted Hedge-Parsley.

Decumbent, spreading, hispid or pubescent annuals, branched at base, branches 6 to 12 in. long; leaves bi-pinnate, segments linear-oblong; umbels sessile or short-stalked opposite the leaves at the nodes, capitate; flowers white; fruit sessile, ovoid, with long prickles often confined to one side. In waste places. May-August. No specimens.

2. *Torilis anthríscus* (L.) Gml. Erect Hedge-Parsley.

Erect, slender, hispid annual, 2 to 3 ft. tall; leaves bi-pinnate, upper may be simply pinnate, segments may be lanceolate, dentate or pinnatifid; umbels slender-peduncled, 1 to 2 in. long; flowers white; fruit ovoid with dense bristles. Adventive from Europe. In waste places. July-September. Hamilton Co.

6. *Dêringa* Adans.

Irregular umbels of white flowers; no involucres or involucels; calyx-teeth obsolete; stylopodium conic; fruit laterally compressed, glabrous; ribs nearly equal; oil-tubes solitary in intervals and beneath ribs.

1. *Deringa canadênsis* (L.) Ktz. Honewort.

Erect, rather slender, freely branching perennial, glabrous, 8 in. to 3 ft. tall; lower and basal leaves long-petioled, 3-parted, segments ovate, serrate, incised, or lobed, 1 to 4 in. long; upper ones nearly sessile, uppermost a margined, incised stalk; umbels of 4 to 10 umblets; fruit glabrous, one-eighth to one-fourth in. long, pointed at both ends. In open woods. May-August. General.

7. *Chaerophyllum* (Tourn.) L.

Small umbels of white flowers; involucre none, or of 1 or 2 bracts; involucels of many linear bracts; calyx-teeth obsolete; stylopodium conic, small; fruit oblong, flattened laterally, ribs equal, oil-tubes solitary in the intervals.

1. *Chaerophyllum procùmbens* (L.) Crantz. Spreading Chervil.

Much branched, slender, spreading annual, 6 to 20 in. tall; decompound leaves, segments ovate, pinnatifid, lower ones slender petioled, upper ones nearly sessile; umbels few rayed, few flowers in an umblet; fruit glabrous or slightly pubescent, one-fourth to one-half inch long, contracted, notched at the base. In moist ground. April-June. General.

8. *Washingtònia* Raf.

Aromatic clustered roots; umbels few rayed; involucres and involucels small or none; calyx-teeth obsolete; fruit elongated, ribs acute, nearly equal, oil-tubes obsolete.

1. Stems and leaves pubescent ..... *W. claytoni*
1. Glabrous or only slightly pubescent at the nodes ..... *W. longistylis*

1. *Washingtonia clàytoni* (Mx.) Britt. Downy or Wooly Sweet-Cicely.

Erect perennials, downy, especially when young, ½ to 3 ft. tall, branched above, stems often stained a dull red; lower leaves ternately decompound, large, often 1 ft. broad, long petioled, the upper ones less compound, nearly sessile; segments ovate, incised, dentate; umbels irregular, long-peduncled, few flowers in umblet opposite leaves; flowers small, white; fruit bristly, ½ in. long, constricted at the base. In woods. General.

2. *Washingtonia longístylis* (Torr.) Britt. Anise-root.

Similar to the preceding species, but glabrous when mature, except at the nodes; leaflets less cleft; fruit about 1 inch long. In woods. May-June. General.

9. *Scándix* (Tourn.) L.

Involucels none or occasionally one bract; petals usually unequal; stylopodium short; fruit linear, flattened laterally, beak much longer than fruit; primary ribs prominent, secondary ribs wanting, oil-tubes solitary or wanting.

1. *Scandix pectenvéneris* L. Venus' Comb.

Slender annual, 6 to 18 in. tall, sparingly pubescent, branched, ascending; leaflets pinnatisected, lobes acute; no involucre, bracts of the involucels notched at the tip; umbels compound; flowers nearly sessile in the umblets; beak of fruit 1½ to 2½ in. long, edged with stiff hairs. Waste places. Fugitive from Eurasia. May-August. Lake Co.

10. *Thâspium* Nutt.

Involucre none or of few small bracts; involucels of several small bracts; all flowers pediceled; calyx-teeth conspicuous, acute; no stylopodium; styles long; fruit ovoid, only slightly flattened dorsally, some or all ribs winged, oil-tubes solitary in intervals.

1. Glabrous, leaves mostly ternate, 1–2 ft. tall..... *T. trifoliatum*
1. More or less pubescent, especially at nodes, biternate, 2–4 ft. tall.....2
2. Leaf segments ovate, acute, serrate, or cleft..... *T. barbinode*
2. Leaf segments pinnatifid into linear-oblong lobes..... *T. pinnatifidum*

1. *Thaspium trifoliàtum* (L.) Britt. Purple Meadow-Parsnip.

Erect glabrous perennial, 1 to 2 ft. tall; basal leaves long-petioled, sometimes simple, cordate, serrate; stem leaves short-petioled, ternate or biternate, segments ovate-lanceolate, crenate, thick; umbels small; flowers yellow or purple; fruit ovoid-globose, all ribs winged. In woods and thickets. April-July. General.

2. *Thaspium barbinòde* (Mx.) Nutt. Hairy-jointed Meadow-Parsnip.

Divergently branched perennials, 2 to 4 ft. tall, pubescent at nodes and sometimes on young shoots and umbels; leaves 1 to 3-ternate, segments ovate, thin, coarsely serrate, acute; umbels small, compound; flowers light yellow; fruit oval, finely pubescent. Along streams. May-June. General.

3. *Thaspium pinnatífidum* (Buckl.) Gr. Cut-leaf Meadow-Parsnip.

Similar to the preceding species, but more pubescent; leaves distant, pinnatisected into numerous linear or oblong lobes, basal leaves large and long-petioled. Woods. June-July. Hamilton Co.

11. *Ligùsticum* L.

Erect herbs with aromatic roots and large umbels of white flowers; involucre of several deciduous bracts or wanting; involucels of numerous linear bracts; calyx-teeth obsolete; stylopodium conic; fruit scarcely flattened, oblong or ovoid, ribs prominent, oil-tubes 2 to 6 in intervals.

1. *Ligusticum canadénse* (L.) Britt. Angelica.

Stout glabrous perennials, much branched, 2 to 6 ft. tall; leaves ternately once or twice compounded, segments ovate, broad, serrate, acute; those of the uppermost leaves lanceolate, entire; umbels compound, sometimes 10 in. broad. In rich woods. June-August.

12. *Coriándrum* (Tourn.) L.

Involucres wanting; involucels of few narrow bracts; calyx-teeth ovate, acute; umblets many flowered; fruit not flattened, ribs slender, oil-tubes solitary; stylopodium conic.

1. *Coriandrum satìvum* L. Coriander.

Slender glabrous annuals, 2 ft. or less tall; leaves pinnately decompound, lower leaflets ovate, deeply cleft and toothed, upper leaves deeply cut into linear segments; umbels compound, 1 to 2 in. broad, peduncles slender; flowers white or pinkish, petals unequal; fruit globose, not divided at commisure. Waste places. Adventitious from Eurasia. No specimens.

13. *Aethùsa* L.

Bracts of involucels setaceous, turned downward to one side; no involucre or a single bract; umbels terminal or opposite leaves; calyx-teeth obsolete, stylopodium broad; fruit dorsally compressed, ribs prominent, nearly equal, oil-tubes solitary in the intervals.

1. *Aethusa cynàpium* L. Fool's Parsley.

Leafy, dichotomously branched annual, 1 to 2½ ft. tall; leaves 2 or 3-pinnately compounded, shining, ultimate segments linear, acute, petiole bases dilated; umbels long-petioled; flowers white; fruit ovoid-globose, slightly flattened. A fetid poisonous herb, adventive from Europe. In waste places. June-October. Lake Co.

14. *Pastinàca* L.

Erect coarse herbs with a fleshy tap-root; usually no involucres or involucels; calyx-teeth obsolete, stylopodium depressed; fruit oval, glabrous, lateral ribs of the 2 carpels contiguous and forming a broad margin to the fruit.

1. *Pastinaca satìva* L. Wild Parsnip.

Biennial or rarely annual herbs, glabrous or slightly pubescent, branched, deeply grooved stem, 2 to 5 ft. tall; leaves pinnately compound, lower often 1½ ft. long, upper much smaller, segments ovate, lobed and incised, dentate, sessile; flowers yellow; fruit broadly oval, much flattened dorsally. The origin of the cultivated parsnip. Some persons are poisoned by touching the leaves. Roadsides and waste places. May-October. Common.

15. *Anèthum* (Tourn.) L.

Involucres and involucels wanting; fruit oblong, much flattened dorsally, lateral ribs winged, dorsal ones slender, sharp; oil-tubes solitary in the intervals.

1. *Anethum gravèolens* L. Dill.

Erect, glabrous, much branched annuals, 1 to 3 ft. tall; leaves finely dissected with sheathing petioled strongly nerved; umbels to 6 in. broad; flowers yellow. Leaves used for seasoning. Introduced from Europe and sometimes escaped from cultivation. July-September. Franklin Co.

16. *Heraclèum* L.

Erect, mostly pubescent herbs; bracts of involucres few or none; involucels of numerous linear bracts; calyx-teeth obsolete or small, petals clawed, obcordate, stylopodium thick; fruit much flattened dorsally, lateral ribs winged, oil-tubes conspicuous in each interval, extending to about the middle of the fruit.

1. *Heracleum lanàtum* Mx. Cow-Parsnip.

Very stout perennials, 4 to 8 ft. tall, stems often 2 in. in diameter at base, ridged, densely pubescent; leaves ternate, segments broadly ovate, irregularly toothed, stalked; umbels 6 to 12 in. broad, peduncles stout; flowers white or pinkish; fruit obovoid, finely pubescent. In moist ground. May-July. Rather general.

17. *Angélica* L.

Tall, erect, branching herbs; involucre none or inconspicuous; involucels small or wanting; calyx-teeth obsolete or small; tip of petals inflexed; flowers white in many-flowered umblets; stylopodium depressed; fruit oval, dorsally compressed, broadly winged.

1. Umbels glabrous or nearly so, leaf-segments acute.....*A. atropurpurea*
1. Umbels densely pubescent, leaf-segments obtuse.....*A. villosa*

1. *Angelica atropurpùrea* L. Great or Purple-stemmed Angelica.

Stout glabrous perennials, umbels occasionally slightly hairy; stems dark purple, 4 to 6 ft. tall; lower leaves often 2 ft. wide, biternate, ovate, acute, thin, sharply serrate; umbels sometimes 10 in. broad; fruit broadly oval. In swamps and moist ground. May-August. Rather general.

2. *Angelica villòsa* (Walt.) B. S. P. Hairy Angelica.

Rather slender perennials, 2 to 6 ft. tall; upper stem and umbels densely tomentose-canescent; lower leaves biternate, segments thick, ovate, obtuse, finely serrate; upper ones much reduced; umbels 2 to 4 in. broad; fruit oval, pubescent. Dry rocky soil. July-September. Eastern half of state west to Adams, Fairfield and Richland Counties.

18. *Conioselínum* Hoffm.

Erect branching herbs; involucre none or inconspicuous; involucels of narrow linear bracts; calyx-teeth obsolete; petals inflexed at tip; stylopodium depressed-conic; fruit oval, flattened dorsally, broadly winged.

1. *Conioselinum chinênsis* (L.) B. S. P. Hemlock Parsley.

Slender glabrous perennials, 2 to 5 ft. tall; lower leaves broad, long-petioled, upper ones nearly sessile, all decompound, leaflets pinnatifid; umbels 1½ to 2 in. broad, peduncles slender; flowers white; fruit oval, ribbed. In swamps and on cold cliffs. August-September. Lake and Summit Counties.

19. *Oxypolis* Raf.

Erect marsh herbs; involucre of few linear bracts or wanting; involucels of several small bracts or none; calyx-teeth acute; stylopodium thick; fruit flattened dorsally, winged, oil-tubes solitary in the intervals.

1. *Oxypolis rigîdus* (L.) Raf. Cowbane.

Rather slender erect perennials, 2 to 6 ft. tall, glabrous; leaves simply pinnate, 3 to 9 leaflets, remotely toothed, linear to lanceolate; 1½ to 3 in. long; umbels compound, broad; flowers white; peduncles slender; fruit oval. Herbage is supposed to be poisonous to cattle. In swamps. August-September. From Erie, Franklin, Ross and Adams Counties westward.

20. *Zízia* Koch.

Erect perennial herbs; flowers yellow, central one of each umblet sessile; involucre none; involucels of several small bracts; calyx-teeth prominent, stylopodium wanting, styles long; fruit ovate to oblong, glabrous, somewhat flattened laterally, not winged, oil-tubes solitary in the intervals and under each rib.

1. Basal leaves ternately compound.....*Z. aurea*
1. Basal leaves simple, cordate.....*Z. cordata*

1. *Zizia aùrea* (L.) Koch. Golden Meadow-Parsnip.

Erect, glabrous, branched perennials, 1 to 3 ft. tall; basal leaves long-petioled, 2 to 3-ternate, leaflets ovate to lanceolate, sharply serrate; upper ones ternate with shorter sheathing petioles, compound umbels, 2 to 3 in. broad; no involucres; petals brilliant yellow, calyx yellowish; fruit oblong. In fields, meadows, and swamps. April-August. Rather general.

2. *Zizia cordàta* (Walt.) D. C. Heart-leaf Meadow-Parsnip.

Stout, erect, branched perennials, glabrous or slightly pubescent; basal and lower leaves simple, cordate or orbicular, crenate, long-petioled; upper ones with 3 to 5 segments, ovate, crenate or lobed; umbels of 7 to 16 umblets; fruit ovoid. May-June. Lorain, Richland, Wyandot, Madison, Franklin, Warren, Gallia, Washington Counties.

21. *Taenídia* Drude.

Involucres and involucels mostly wanting; flowers yellow, calyx-teeth obsolete; fruit flattened laterally, oil-tubes numerous; stylopodiums broad, conic.

1. *Taenidia integérrima* (L.) Drude. Yellow Pimpernel.

Slender branching perennial, glabrous, glaucus, 1 to 3 ft. tall; leaves 2 to 3-ternate, lower long-petioled, upper with short dilated petiole, segments oval, entire; umbels of 10 to 20 umblets, peduncle slender; fruit oblong, short, glabrous. Dry sandy or gravelly woods. May-June. General.

22. *Àpium* (Tourn.) L.

Involucre of 2 to 4 linear bracts; calyx-teeth obsolete, stylopodium conic, short; fruit ovate, ribs filiform, oil-tubes solitary in intervals.

1. *Apium petroselìnum* L. Garden Parsley.

Erect, much branched biennial, 1 to 3 ft. tall, glabrous; lower leaves decompound, leaflets ovate, much incised, upper leaves linear-oblong and entire; umbels spreading, 1 to 2½ in. broad, axillary and terminal; flowers greenish-yellow and inconspicuous; fruit ovoid, glabrous. Escaped from gardens. Introduced from Europe and cultivated for its leaves and roots. Summer. Madison Co.

23. *Foenículum* Mill.

Stout aromatic herbs; involucres and involucels wanting; calyx-teeth obsolete, stylopodium large, conic; ribs prominent, oil-tubes solitary in intervals.

1. *Foeniculum foenículum* (L.) Karst. Fennel.

Glabrous, branched perennial, 2 to 4 ft. tall; leaves finely dissected into numerous filiform segments; petioles broad, clasping umbels large, peduncles rather glaucous; no involucres or involucel flowers yellow; fruit oblong, nearly terete, glabrous. Leaves have medicinal value. Native of Europe, escaped from cultivation. July-September. Hocking, Scioto, Erie Counties.

24. *Bupleùrum* (Tourn.) L.

Erect herbs with simple, entire, clasping or perfoliate leaves; no involucres, involucels of 5 conspicuous bracts, about as long as the peduncles; calyx-teeth obsolete, tip of petals inflexed, stylopodium conic; fruit oval, flattened laterally, no oil-tubes.

1. *Bupleurum rotundifòlium* L. Hare's Ear or Through Wax.

Smooth, branching annuals, 1 to 2 ft. tall; leaves ovate, entire, perfoliate; terminal umbel or yellow flowers, 3 to 6 umblets; involucels very conspicuous; fruit smooth. In fields. From Europe. July-August. Warren Co.

25. *Conium* L.

Involucres and involucels of ovate acuminate bracts; calyx-teeth obsolete, petals obcordate, tip inflexed; fruit glabrous, slightly flattened laterally; carpels wavy-ribbed, oil-tubes none, but have a layer of oil-secreting tissue.

1. *Conium maculàtum* L. Poison Hemlock.

Much branched, glabrous biennial, 2 to 5 ft. tall; stems spotted with purple; lower leaves petioled, upper nearly sessile, all decompound, leaflets pinnatifid, petioles much dilated at base; umbels 1 to 3 in. broad, peduncles slender, 1 to 1½ in. long; flowers white; fruit oblong with prominent ribs. The whole plant, especially the seed is poisonous to man and animals. In waste places. June-July. Montgomery, Knox, Lake Counties.

26. *Sium* (Tourn.) L.

Erect herbs with stem leaves simply pinnate, lower ones often pinnatisected; involucres and involucels of many narrow bracts; calyx-teeth minute, tip of petals inflexed; ribs prominent, oil-tubes 1 to 3 in intervals.

1. *Sium cicutaefòlium* Schrank. Water-parsnip.

Stout, branched perennials, 2 to 6 ft. tall; leaflets variable, linear, in pairs, 7 to 17, acute, serrate, lowest are often finely dissected; umbels terminal and axillary, 2 to 3 in. broad; flowers white; fruit ovate, compressed, ribs prominent. Supposed to be poisonous to stock. In swamps. July-October. General.

27. *Aegopòdium* L.

Involucres and involucels wanting or rarely few deciduous bracts, umbels dense; calyx-teeth obsolete, petals inflexed, stylopodium conic; umblets many-flowered; carpels obscurely 5-angled, ribs equal, filiform, no oil-tubes.

1. *Aegopodium podogrària* L. Goutweed.

Coarse glabrous perennial, 1½ to 2½ ft. tall, from a creeping root-stock; lower leaves biternate, primary divisions stalked leaflets ovate, acute or acuminate, often oblique at base, sharply serrate, upper leaves simply ternate; umbels 1½ to 2½ in. broad; flowers white; fruit oblong, styles deflected. In waste places, adventive from Europe. June-August. Lake Co.

28. *Pimpinélla* L.

Erect herbs with stem leaves simply pinnate, lower often pinnatisected; involucre and involucels of many narrow bracts; calyx-teeth minute, tips of petals inflexed; ribs prominent, oil-tubes 1 to 3 in intervals.

1. *Pimpinella saxífraga* L. Pimpernel.

Glabrous, branched perennials, 1 to 2 ft. tall; segments of lower leaves 9 to 19, ovate, sharply serrate and incised, upper ones of fewer and narrower segments; umbels terminal and axillary, peduncles slender, 7 to 20 umblets; flowers white; fruit ovate to ovoid, compressed. Roadsides and waste places. Adventive from Europe. June-October. No specimens.

29. *Cicùta* L.

Erect herbs with compound terminal umbels of white flowers; involucre of few bracts or none, involucels of many bracts; calyx-teeth prominent, acute, stylopodium depressed; fruit slightly flattened laterally, ribs corky, oil-tubes solitary in intervals.

1. Stout, leaf-segments lanceolate to lanceolate-oblong..... *C. maculata*
1. Slender, leaf-segments linear..... *C. bulbifera*

1. *Cicuta maculàta* L. Water Hemlock, Wild Parsnip.

Stout, branching, glabrous perennials, 3 to 6 ft. tall, from fleshy roots; stems marked with purple lines; lower leaves large, often 1 ft. long, 2 to 3 pinnate, long petioles, upper leaves smaller, leaflets ovate to lanceolate, sharply and coarsely serrate umbels many-flowered, pedicels unequal; flowers white; fruit shallowly grooved at commisure. Whole plant violently poisonous to man and animals. Has destroyed many human lives. June-August. In moist soil. General.

2. *Cicuta bulbífera* L. Bulb-bearing Water-Hemlock.

Slender much-branched perennials, 1 to 3½ ft. tall; lower leaves 2 to 3-pinnate, segments linear, sparingly serrate, upper ones less divided and bearing clusters of bulblets in axils. Supposed to be very poisonous. In swamps. July-September. Northern part of the State to Perry and Clark Counties.

30. *Eùlophus* Nutt.

Involucres of one bract or none; involucels of narrow acuminate bracts; calyx-teeth prominent, petals obovate, tip inflexed, stylopodium conic; fruit glabrous, styles persistent, recurved, ribs filiform, 1 to 5 oil-tubes in intervals; umblets many-flowered.

1. *Eulophus americànus* Nutt. Eastern Eulophus.

Slender glabrous perennials, 3 to 5 ft. tall, from deep tuberous roots; basal and lower leaves large, long-petioled, 2 to 3-divided into linear segments, upper leaves similar but smaller and with shorter petioles; umbels terminal, 2 to 4 in. broad, peduncles slender; flowers white or pinkish; fruit oblong. In dry soil. July. No specimens.

31. *Càrum* L.

Involucres and involucels of few to many bracts, inconspicuous, and may be early deciduous; calyx-teeth minute, petals inflexed, stylopodium conic; fruit slightly compressed laterally, ribs filiform, oil-tubes solitary in intervals.

1. *Carum càrui* L. Caraway.

Branching, glabrous biennials or perennials, 1 to 2 ft. tall; all leaves pinnatisected into filiform or linear divisions, bases of petioles much dilated; umbels 1 to 2½ in. broad; flowers white, occasionally pink or yellowish; fruit oblong, ribs conspicuous. Seeds have medicinal value and are used in flavoring. Native of Europe. Escaped from cultivation. May-September. Columbiana, Lorain, Ashland, Fulton Counties.

32. *Céleri* Adans.

Involucre and involucels small or none; calyx-teeth obsolete, petals obovate, inflexed at the tip, stylopodium depressed; carpels 5-angled, ribs prominent; umbels terminal and opposite the leaves.

1. *Celeri gravèolens* (L.) Britt. Celery.

Erect glabrous perennials, 1 to 3 ft. tall; leaves pinnate, lower ones long stalked, upper nearly sessile, leaflets thin, broadly ovate, coarsely toothed and incised; umbels of 2 to 7 umblets, opposite the leaves and terminal; flowers very small, white; fruit ovoid, small. Petioles are eaten and seeds used in seasoning. Native of Europe. Escaped from cultivation. May-July. Highland County.

33. *Erigenìa* Nutt.

Glabrous herbs from a deep tuber; calyx-teeth obsolete, petals flat, obovate or spatulate; fruit nearly orbicular, notched at both ends, ribs slender, oil-tubes in intervals.

1. *Erigenia bulbòsà* (Mx.) Nutt. Harbinger of Spring. Pepper and Salt.

Nearly acaulescent perennials, scapose stem, 3 to 9 in. tall; leaves few, petioled, 2 to 3-ternate, segments oblong, obtuse; upper one involucrate, smaller, short-petioled, petioles much dilated at base; umbels terminal, compound, few umblets; flowers white, anthers dark purple; fruit broader than long. Deciduous woods. February-June. General.

A REVIEW OF THE GENUS ERISTALIS LATREILLE IN NORTH AMERICA.

Part II.*

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The studies below represent a continuation of those which were published in the Ohio Journal of Science a short time ago. In all, seven species have been described as new. These represent species which the writer has been unable to place in existing descriptions. These older descriptions, however, of unrecognized species, are in no slight degree vague and indefinite, and in few cases is one able to feel sure of their characterization. Hence, it is not entirely impossible that when the types of these old species are examined (according to the evidence of several authors, some of these are no longer in existence), one or two of the present described species may be found identical. Many of the old descriptions, are, as has been noted by others, a characterization more applicable to a genus or a group, rather than to any definite species.

Mention was made in Part I of these studies, of a discussion of the remaining unrecognized species from North America. It has not been found practical to include this here and the treatment of these remaining forms has been reserved for a future paper.

The Scutellaris Group.

(Group description.)

The forms placed here make a rather unique group, distinguished chiefly by their elongated abdomen and thickened hind femora. Unlike the species of the following group, while sometimes brilliantly marked with yellow, they are usually, for the larger part black or brown.

Of moderate size to large; very scantily and short pilose. Head more or less hemispherical, slightly variable in shape. Eyes pilose on the upper half. Frontal triangle just above the antennæ, obtusely projecting in the male; slightly projecting in the female. Antennæ of the usual size; arista bare.

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* Part I, see this Journal: Vol. XXV, p. 11, Jan., 1925.

Thorax opaque, transversely fasciate, and often marked by shining cross bands. Abdomen long and slender, widest on the second segment, thence tapering posteriorly. Hind femora considerably thickened; hind tibiæ flattened and arcuate, with a sharp apical spur.

The above assemblage of characters will be seen to embrace those used by Williston to designate his species of *Doliosyrphus*, a genus hardly tenable, based as it is, chiefly on the protruding frontal prominence of the male. This is to be found to but a slight extent, in the females. The elongate condition of the abdomen is found to have intermediate forms in such species as *æmulus*, *agrorum*, and *spectabilis*. While these forms are readily placed within the group, they are but little more elongate than the usual *Eristalis*.

KEY TO THE SPECIES OF THE *Scutellaris* GROUP.

1. Hind femora yellowish to reddish.....*precipuus* Will.
   Hind femora black or brown.....2
2. Velvet black bands of thorax broken up into spots.....*cyatheus* sp. n.
   Velvet black bands continuous.....3
3. Scutellum in a large part black.....*volaticus* Will.
   Scutellum not in large part black.....4
4. Scutellum brown in color.....5
   Scutellum wholly yellow.....6
5. Light spots on the third and fourth segments of the abdomen...*æmulus* Will.
   Fourth segment, and usually whole of third segment, black..*spectabilis* n. sp.
6. Third joint of antennæ light yellowish red.....*agrorum* Fabr.
   Third joint of antennæ black or nearly so.....7
7. Median opaque stripe of second segment of abdomen does not reach the posterior band; hind tibiæ reddish to brown (female).....*conicus* Fabr.
   Median opaque stripe of second abdominal segment reaches the posterior band; hind tibiæ black or nearly so.....8
8. Margins of scutellum fringed with dense stubby black pile. (Male, female). *conicus* Fabr.
   Scutellum not thus fringed; only scattering brownish hairs..*scutellaris* Fabr.

Eristalis precipuus Will.

(Plate I, Fig. 8.)

Male; female. Antennæ dark reddish brown. Bare area of cheeks, narrow; together with facial stripe, shining dark brown. Pile of face dense, appressed, silvery, totally obscuring the ground color. Pile of lower half of front, just above antennæ, black. Thorax opaque gray, marked as follows: an opaque velvet black band extending between the humeri, widely interrupted medianly; a second black band, practically continuous, immediately behind the suture. Immediately in front of this (presutural), is a very narrow, widely interrupted, silvery line or band; immediately behind the suture, a wide steely blue band. Pleuræ largely silvery gray pollinose. A small spot above the base of the wings likewise silvery gray pollinose. Scutellum yellow, narrowly black basally. Abdomen opaque black; second segment with a pair of large, quadrate yellow spots, reaching the margin in their full length. Third

segment with similar yellow spots, narrowly connected on the anterior margin. Fourth segment with a complete steel blue, shining cross band; median black of second and third segments extended along the posterior margin to the sides. Segments two, three and four with a narrow yellow posterior margin. Yellow spots of female often obsolescent, becoming metallic steel blue. Legs light yellowish brown; pile long, whitish. Last two joints of all the tarsi blackish, pile black. Wings nearly hyaline, slightly grayish. Length 15 mm.

Description drawn from one female; Sao Paulo, Brazil, (collection Mr. C. H. Curran), and the description by Williston, Trans. Amer. Ent. Soc., Vol. XV, p. 280. The typical specimens were from Chapada, Brazil.

Eristalis cyatheus n. sp.

(Plate I, Fig. 9; Plate II, Fig. 13.)

Female. Facial stripe and cheeks, shining, jet black. Face very scantily clothed with light, white pollen; black ground color plainly apparent. Facial stripe limited to the tubercle, the latter more prominent than in *scutellaris*. Pile of lower half of front, or just above antennæ, black. A few hairs below antennæ black, becoming white and more numerous along the sides, lower down. An opaque black band extending across the middle of front, to the margins of the eyes, and a band before and behind, silvery pollinose. Antennal prominence shining black, an opaque triangular black spot just above the apex directed towards the vertex. Antennæ lacking. Thorax dark gray, feebly shining, marked as follows: A large, opaque, velvet black spot in the anterior lateral corners of the dorsum, a wide anterior median black band (may be narrowly divided medianly) produced posteriorly, not reaching the suture, and a large, subtriangular, opaque black spot, just behind the suture, on either side. Pleuræ black, sparsely white pilose. Scutellum deep, opaque, velvet red. Abdomen shining black, with a slight steely blue cast, marked with opaque black as follows: A small, median, quadrate spot on the anterior margin of the second segment, together with a median interrupted band on the posterior margins of the third and fourth segments. Very narrow, yellow posterior margins, on segments two, three and four. All the femora shining black. All the tibiæ and tarsi yellowish red. Wings grayish hyaline, with a large blackish spot on the outer half, sharply defined basally. Length 15 mm.

One female, San Sebastian, Brazil. Type in the collection of Mr. C. H. Curran.

Eristalis volaticus Williston.

Male. Facial stripe, cheeks, and front, shining black. Face deeply obscured by dense, pale yellowish to whitish pollen. First and second joints of antennæ dark blackish brown, third light reddish; arista yellow. Thorax gray, feebly shining, marked vaguely by a large, opaque

black spot in each lateral anterior corner, almost continuous medianly, and a similar, broken band, just back of the suture; a median black stripe produced posteriorly, not reaching the suture. Pleuræ, black, largely dark brownish pilose. Scutellum yellow, wholly obscured, except for a small round spot apically, by dense, woolly or curly, velvet black or reddish brown pile. Second and third segments of abdomen wholly yellow, except as follows: a narrow, median black stripe, of uniform width, on both segments, interrupted on the posterior margin of the second, by the yellow posterior margins; in the second segment, slightly dilated posteriorly, in the third the dilation becomes a band, reaching the side margins of the segment. Fourth segment wholly black save for the narrow yellow posterior margin. All the femora wholly shining black. Basal half of tibiæ light yellowish brown, remainder of tibiæ and tarsi black; clothed with short, dense, whitish or yellowish hair. Wings clouded with brown, especially along the anterior margin. Length 9–11 mm.

One specimen, San Sebastian, Brazil, and a part of the Williston material, Chapada, Corumba, and Rio de Janeiro, studied.

Eristalis æmulus Will.

(Plate I, Fig. 1; Plate II, Fig. 18.)

Male, female. Antennæ dark brown, arista of the same color. Facial stripe and cheeks, shining reddish brown. Face obscured by dense, appressed, pale yellowish white pile and pollen, extending a part of the way up the front, along the eyes. Front dark brown, vertex black; pile dark. Thorax marked by four bands before the scutellum, the first three of nearly equal width, and continuous; between the humeri, an opaque gray band, immediately behind is an opaque black band, followed by a band with a strongly steel blue cast; immediately before the suture is found the usual, narrow, interrupted, white pollinose band or line. Just past the suture is a wide, black, continuous band; remainder of the thoracic dorsum, strongly steel blue. Scutellum light brown, feebly shining on the rim. Second segment of the abdomen light brown, subtranslucent, marked with black, or very dark brown, as follows: A median stripe of nearly equal width, continuous posteriorly with a narrow band on the posterior margin. Third segment of a similar color, with a wide posterior marginal band, and a round, median spot, black. Fourth segment sometimes with a small light spot on either side, widely separated by black; a shining cross band on the middle of the segment; other parts of abdomen opaque or very feebly shining. Sides of all the segments, very narrowly blackish; narrow, yellow, posterior cross bands present. Abdomen of a peculiar shape, very wide on the second segment, tapering slightly and very suddenly tapering on the third segment; fourth segment less than a third the width of the second, tapering slightly. Abdomen not very greatly longer than broad. Legs more or less evenly dark brown, shining; tibiæ and tarsi lighter in color. Wings with the usual brown clouds apically. Length 14 mm.

Recorded by Williston, from Mex., Guatemala, and Panama. Nine specimens, from Bartica, British Guiana, June, July. Collections of Ohio State University and Mr. C. H. Curran.

The difference in the contiguity of the eyes of the male, between this species and *agrorum*, is very slgiht indeed. Williston further describes the hind femora of *æmula* as slenderer than *agrorum;* actually it is the reverse, though the difference is slight. There is moreover, in *æmulus*, a slight, elongate protrusion, on the lower surface of the hind femora, apically, lacking in the other species; the hind tibiæ are more arcuated.

Eristalis spectabilis n. sp.

(Plate I, Fig. 2.)

Female. Antennæ dark reddish brown; arista of the same color. Facial stripe and cheeks shining black. Ground color of face densely obscured by appressed, silvery pile. Front blackish, pile black. Thorax gray, moderately shining, marked by an opaque, velvet black band, continuous between the humeri, and a similar, wider band just behind the suture. Just before the suture, is a widely interrupted, very narrow, silvery pollinose band. Scutellum brown, slightly shining. Abdomen black, largely shining; marked as follows: Two, large, subquadrate, or roughly oval, dark shining, slightly reddish brown spots on the second segment, separated medianly by chiefly opaque black stripe, the latter continuous with a black posterior margin. Small spots of the same color as those on the second, in one specimen, on the anterior margin of the third segment, widely separated by black. Black of third and fourth segments shining, a small median spot anteriorly on the third, opaque. Side margins of all the segments black. Usual narrow yellow posterior bands present. Legs shining black; tibiæ dark brow, lighter basally. Wings heavily clouded with brown, especially on the apical half. Length 15 mm.

Type female and two paratype females, Caura Val., Venzuela, collection of C. H. Curran. The species resembles somewhat, a very blackish, smoky, *vinetorum*, but is very different in a number of respects, besides being elongate. It is, however, not very greatly elongate, and resembles *æmulus* in this respect, the drawn out fourth and fifth segments contributing to this appearance. Much darker and blacker than the preceding species. The male probably resembles *æmulus* in shape.

Eristalis agrorum Fabr.

(Plate I, Fig. 3.)

Male, female. Antennæ and facial stripe light brownish red; cheeks very dark, shining, brownish red. Front, shining, dark reddish brown,

above antennæ, becoming more opaque and brownish black towards the vertex. Face obscured by dense, appressed, pale yellowish white pile and pollen. Thorax nearly opaque, slightly brownish or yellowish gray, marked by black as follows: A narrow continuous band between the humeri; a similar band, about three times the width of the first, immediately behind the suture, slightly crescentric; narrow, white, pollinose, interrupted band before the suture, scarcely present. Scutellum yellow, opaque, sometimes tinged with red. Second abdominal segment yellow, marked by a rather slender, median, black stripe, wider in the female, usually more slender posteriorly, and continuous with a quite narrow, sometimes obsolescent, posterior marginal band. Third segment likewise yellow, with a black, posterior marginal band; in the male, with median, contiguous, round black spot on the anterior margin, and in the female, a similar, quadrate spot. Fourth segment wholly black, with a transverse, medianly interrupted, metallic cross band. Segments two, three and four, with narrow yellow hind margins. Femora shining black; hind tibiæ dark brown, front tibiæ, and middle tibiæ more extensively, pale yellowish basally. Tarsi black. Wings nearly hyaline, sometimes slightly infuscated. Length 15 mm.

Material studied consists of that recorded by Williston from Chapada, Brazil. The abdomen is not especially elongate, and is more flattened than is common among the genus. Similar to *vinetorum* especially in the markings of the thorax, but presenting numerous differences. In that species the scutellum is uniformly brown, as are the markings of the abdomen. In *agrorum*, while often tinged with red, the markings are distinctly yellow, at the most, tinged with brown. It is a rather light colored species.

Eristalis conicus Fabr.

(Plate I, Fig. 6.)

Male, female. Antennæ dark brownish black; third joint one and a half times as long as broad, arista reddish brown. Facial stripe, front and cheeks, shining black. Cheeks densely white pollinose, in the female extending narrowly up along the eyes, to nearly half the length of the front. Thoracic pattern similar to that of *scutellaris*. Scutellum yellow, heavily fringed on the margin with dense, stubby, black pile, wholly opaque. Median black band of second segment of the abdomen, not continuous in the female, with the posterior marginal black band of that segment, thus differing from the female of *scutellaris*. Abdominal markings otherwise as in *scutellaris*. All the femora shining black; hind tibiæ dark reddish brown; hind tarsi, front and middle tibiæ and tarsi, rather light brownish red. Wings heavily clouded, particularly on the apical half. Length 10–12 mm.

About thirty specimens studied. Recorded from Bartica, Kartabo, British Guiana; Rio de Janeiro, Chapada, Brazil;

and Livingston, Guatemala. Collection of C. H. Curran, Ohio State University and the author. A species remarkably close to *scutellaris*, but distinguished in the female, by the discontinuous, opaque black band of second segment, lighter colored tibiæ and tarsi, and in the male, by the scutellum being always beset with dense black bristles, longer antennæ, etc. They seem to differ fairly constantly in size.

Eristalis scutellaris Fabr.

(Plate II, Figs. 16, 19.)

Male, female. Antennæ very dark brownish black, third joint slightly longer than broad; arista black. Front, facial stripe and cheeks, shining black. Face heavily obscured by dense silvery pollen. Pile of face and occiput, sparse, silvery; of front and vertex, black; of eyes, light, slightly reddish brown. In the female, the silvery facial pile extends narrowly up along the orbits, half the distance of the front. Thorax gray, feebly shining, marked as follows: a narrow, black, opaque band, continuous between the humeri, in one specimen extending widely, anteriorly, between the humeri; a second wider, similar band, immediately behind the suture, followed by a wide, shining steel band. Before the suture is found a narrow, widely interrupted, silvery pollinose band, in one specimen rather yellowish. Pleuræ largely brownish gray, pale pollinose. Scutellum deep yellow, very narrowly black basally, wholly opaque. Abdomen opaque black, marked as follows: A pair of large, sharply quadrate, yellow spots on the second segment, separated medianly, from each other, and posteriorly from the margin, by a black band. Margins frequently narrowly black. Third segment similar. Fourth segment wholly black, a continuous, transverse, steely blue band in the middle. Segments two, three and four, with narrow yellow margins. Yellow spots of female usually obsolete; replaced by shining, steely blue. Legs shining black; anterior and middle tibiæ largely dark shining red. Wings heavily clouded with black, particularly on the apical half. Length 14–16 mm.

Thirty-five specimens studied. A large and brilliantly marked species, with an extensive synonomy. Recorded from Chapada, Rio de Janeiro, Brazil; Kartabo, Bartica, British Guiana; Mexico, New Mexico and Panama. Material studied is from the collections of C. H. Curran, Ohio State University, R. C. Shannon and the author.

The Aeneus Group.

(Plate II, Figs. 17, 20.)

Species distinguished primarily by the spotted eyes, and by the bare eyes on the upper half. The thorax is usually longitudinally striped and the species are often metallic in coloration. A group containing a large number of Oriental and African species, often separated under the genus *Lathyrophthalmus*. The species are, as Bezzi has remarked, quite variable in some of their characters. Still the group is a useful one. Many of the species are of brilliant coloration and this is particularly true of the sole representative in North America. The latter, *Eristalis æneus* Scop., is a common, widespread and well known species. It is slightly smaller than the average *Eristalis*, almost wholly metallic greenish or brassy, usually with five opaque longitudinal vittæ on the dorsum of the thorax. According to Herve Bazin, the form with striped thorax is the variety *taphicus* Wd. This form is represented in Figure 17. The arista is bare, microscopically pubescent.

The Dimidiatus Group.

(Group description.)

Eyes pilose on the upper anterior portion. Antennæ typically dark brown, red or black; arista plumose to bare and microscopically pubescent. Cheeks shining black; ground color of face dark, pile light in color. Facial stripe and prominent "knob" or tubercle, shining black to dark brown or red. Pile of vertex and the lower part of occiput rather long abundant.

Thorax some shade of dark brown or black; usually highly shining and unicolorous; sometimes very obscure darker areas may be seen at an angle. Scutellum likewise shining, as a rule nearly concolorous with the thorax. Pleuræ black or brown. Pile of thorax and scutellum abundant but rather short, generally light in color.

Abdomen in most species highly shining, less so on the second segment; following segments rarely wholly shining, usually with posterior or anterior opaque marginal bands, often interrupted or broken up into spots. Light colored spots of fore part of abdomen always more distinct in the male, very often obsolete in the female, occasionally in the male. Segments two, three and four with the characteristic narrow yellow marginal bands posteriorly. Pile thick but quite short; variable in color. Legs usually characteristically marked; mostly shining black, with the basal half of all the tibiæ sharply yellow, sometimes whitish. Hind femora slender. Wings seldom wholly hyaline, usually with an infuscation on the anterior half, heaviest about the stigma, sometimes with a well defined black or brownish spot; decidedly variable.

One of the most troublesome groups in the genus. The recognition in this country of *nemorum* and *rupium*, both European species, by Dr. R. C. Osburn (Jour. New York Ent. Soc. XXIII,

139) and the variability of certain forms, together with some little sexual dimorphism in certain species, all adds to their complexity and the difficulty of separating them out. Distinctions between species, based on wing markings, are highly variable and untrustworthy; only *dimidiatus* has really hyaline wings and it not perfectly. The black opaque markings of the third abdominal segment, so often made use of, are distinct in only three species and in the remainder variable. The characters here used are a combination of the opaque markings of the abdomen, color of the legs, pile, antennæ and general coloration. Great care has been taken to use those characters most easily discernible and least variable; with all the caution that has been used there must still remain many imperfections. The group is considered characterized by their general strong shining appearance and comparatively short pile, usual dark coloration, etc., in contrast to more opaque species such as *arbustorum*, *brousi*, etc. This latter group finds several members in Europe. As it cannot be denied that certain specimens of *arbustorum* and *brousi* become somewhat "shining on the thorax," though decidedly opaque upon the abdomen, these two species have also been included in the key. The plumosity of the arista in the dimidiatus group varies considerably. We find on one hand, tolerably plumose species such as *rupium*, with ten to twelve plumulæ, *saxorum* with six or eight, *dimidiatus* with only two or three, and on the other hand *latifrons* with none. In *obscurus* there are a number of short hairs; it can hardly be called plumose.

Among the older species of this country, *obscurus* seems not to have been well understood; large series of what I have considered this species, as well as several other species, have been taken by Professor J. S. Hine in Alaska, and have enabled the writer, perhaps, to characterize them better. *Eristalis inornatus* has not been certainly recognized. Originally described from a single poorly preserved specimen. Although it has been reported as taken several times since, the writer feels sure that most if not all of these have been confused with other members of the group; one specimen that has come to hand, identified as *inornatus*, turns out to be *rupium*.

KEY TO THE SPECIES OF THE *Dimidiatus* GROUP.

1. Basal third of hind tibiæ light yellowish.....2
   Basal third of hind tibiæ not of this color (*obsoleta* group).....*tenax* Linne.
2. Basal two-thirds of wing margin brown in color.....*compactus* Walk.
   Basal two-thirds not of this color; nearly or completely hyaline or with infuscated spot near stigma.....3

3. Posterior margin of third segment with a fringe of pale golden pile; opaque markings limited to two widely separated oval spots, or entirely lacking. *latifrons* Lw.

   Not with a fringe of pale golden pile on third segment; opaque markings usually in the form of bands, sometimes spots, rarely absent....4
4. Thorax deep bluish black; opaque bands of third abdominal segment complete; wings always with a spot in neighborhood of stigma...*saxorum* Wied.

   Thorax not of that color....5
5. Third abdominal segment with a widely interrupted opaque cross band; third and fourth segments each with a small median, anterior opaque spot; wings hyaline....*dimidiatus* Wd.

   Third and fourth segments of abdomen not as above; wings hyaline or infuscated....6
6. Males....7

   Females....13
7. Basal joints of hind tarsi pale in color....*rupium* Fabr.

   Basal joints of hind tarsi dark....8
8. Third and fourth abdominal segments with a median, opaque, elongate spot..9

   Third and fourth abdominal segments not with such a spot....10
9. Spots of second abdominal segment highly shining at least in part, yellow; pile of thorax light yellow; shining facial stripe prominent....*temporalis* Thomp.

   Spots of second abdominal segment opaque or very feebly shining; pile light brownish to reddish; facial stripe usually quite narrow or lacking....10
10. Yellow of second and third segments confluent for nearly its width; dorsum of thorax usually with faint darker spots; shining facial stripe very narrow to obsolete....11

    Black of second segment posteriorly reaching nearly to the lateral margins; thorax entirely unicolorous; shining facial stripe prominent....12
11. Basal joint of middle tarsi yellowish except at tip; a transverse basal band of opaque black on fourth segment....*arbustorum* Linne

    Basal joint of middle tarsi entirely brown; fourth segment with a minute basal spot of opaque black or entirely shining....*brousi* Will.
12. Pile of face and thorax yellowish to reddish; usually with light spots on third abdominal segment; ground color of face light....*nemorum* Linne

    Pile of face and fourth abdominal segment white; light spots only on second segment; ground color of face black....*obscurus* Lw.
13. Second abdominal segment very feebly shining; dorsum of thorax with faintly indicated darker spots; shining facial stripe very narrow or lacking (*arbustorum* group)....14

    Second abdominal segment at least in part highly shining; thorax entirely unicolorous; facial stripes quite prominent....15
14. Basal joint of middle tarsi yellowish except at tip; a transverse basal band of opaque black on fourth segment....*arbustorum* Linne.

    Basal joint of middle tarsi entirely brown; fourth segment with a minute basal spot of opaque black or entirely shining....*brousi* Will.
15. Light markings of second abdominal segment usually large or quite distinct; third and fourth segments with a median opaque elongated spot; pile yellowish, never brownish on dorsum of thorax....*temporalis* Thomp.

    Light markings usually nearly obsolete or much suppressed....16
16. Thorax more brown; pile brownish to reddish....*nemorum* Linne.

    Blackish species, particularly on the thorax; pile pale yellow to whitish...17
17. Basal joints of hind tarsi pale; third joint of antennæ red to dark reddish brown; infuscated spot of wing quite distinct at least from the basal half of the wing. *rupium* Fabr.

    Basal joint of hind tarsi dark in color; third joint on antennæ black, never dark brown or red; infuscation of wing much lighter and diffused over the whole basal anterior portion of wings to stigma (see discussion under *temporalis*. *obscurus* Lw.

Eristalis dimidiatus Wied.

Male, female. Antennæ black. Facial stripe and cheeks shining black; ground color of face black; pile of face, vertex and front pale yellowish white, on upper part of vertex black. Thorax wholly shining greenish black, with three very faint opaque vittæ; scutellum nearly concolorous. Pile of thorax wholly pale yellowish. Second segment of abdomen black, a light brownish spot on either side, occasionally obsolescent, is separated by black in the middle of the segment. Remaining segments wholly black. Third and fourth segments wholly shining save for a median anterior opaque spot on each and an oval spot on each side of the third segment, posteriorly. Posterior marginal bands of segments whitish. Legs shining black, the basal half of all the tibiæ pale yellowish white, usually sharply marked. Wings hyaline, rarely with a slight infuscation on the middle of the anterior half. Length: 10–13 mm.

Perhaps the commonest, or at least the best known species in the group. The characters that at once mark the species are its black color, greenish or brownish black thorax, characteristic opaque spots of third and fourth segments and the whitish areas on the tibiæ.

Eristalis latifrons Lw.

Male, female. Antennæ black, arista bare to microscopically pubescent; facial stripes and cheeks shining black. Pile of face, front and vertex, pale yellowish white, longer than in most species of the group. Thorax greenish brown, shining, with no traces of opaque markings. Scutellum yellowish brown. Pile of thorax rather thick, yellow. Abdomen greenish black; first segments with yellowish brown spots on each side, widely separated medianly, frequently obsolescent or totally absent. Abdomen wholly shining; an interrupted opaque posterior band on the second segment, occasionally an oval, opaque spot on each side of the third segment in the male. Posterior margins of second, third and fourth segments whitish, with a characteristic fringe of rather long, pale pile. Apices of femora and abasal half of tibiæ yellowish; legs otherwise shining black. Wings sometimes hyaline; usually with a brownish spot in the middle of the anterior half. Length 9–14 mm.

A widespread species, more abundant in the southern half of the United States. The almost wholly shining abdomen, marginal fringe of whitish pile, greenish color, etc., all serve to make the species a characteristic one.

Eristalis saxorum Wied.

Male, female. Antennæ black, sometimes dark reddish brown; arista slightly plumose basally. Facial stripe, cheeks and ground color of the face, black. Pile of face white, of upper half of front and vertex,

black. Thorax black, with strong metallic bluish reflections. Scutellum of a similar color and reflection; but often dark reddish brown. Pile of thorax short, longer on the pleuræ, pale in color. Abdomen black; a light brownish spot on either side of the second segment, quite frequently obsolescent, and widely separated medianly; narrow yellow posterior marginal bands usually prominent; often with a quite strong bluish tinge, and the segments highly shining, even sometimes metallic. Second segment largely opaque save on the spots; third and fourth segments with characteristic opaque, marginal bands, on both anterior and posterior portions, the anterior band sometimes obsolescent. Legs typical for the group; light area of the tibiæ, whitish. Wings always with a fairly well defined brown stripe or spot, on the middle and anterior half, variable in extent. Length 10–13 mm.

A common, well known species, seemingly limited to the northern half of the eastern United States. Professor J. S. Hine tells me he has never met with the species in Ohio. It is recorded from the District of Columbia. My material is from Massachusetts and New York. Distinguished by its strongly steel blue coloration, and largely shining to metallic abdomen.

Eristalis compactus Walk.

Male, female. Antennæ, bright brownish orange, in two specimens reddish brown; quite large, two-thirds to twice larger than usual. Facial stripe wide, it and cheeks shining black; ground color of face black. Pile of face light, rather short and sparse, in considerable contrast to such forms as *latifrons*, *nemorum*, etc.; pile yellowish on front and vertex and black about the ocelli, sometimes black on the front likewise. Face more produced below than in other species. Eyes wholly pilose. Thorax dark shining brown, scutellum strongly reddish; pile of former light yellowish brown on top, reddish on the sides; on the latter black upon the disc, yellowish on the margin. Abdomen black, the spots of the second segment strongly reddish; the narrow yellow posterior marginal bands very prominent, largely shining; opaque bands on the second, third and fourth segments, often obsolescent. Pile on spots of second segment bright golden red. Legs yellowish red, basal half of hind femora, greater part of front and middle femora and last two joints of the tarsi, black. Wings with a characteristic brownish band on anterior basal portion of wing. Length 9–10 mm.

A short, stout, compact little *Eristalis*, well deserving its name. The band of the wing and the shining reddish coloration separate it at once from its congeners. Specimens studied are from New York and New Hampshire. Specimens received from Mr. Raymond C. Shannon were taken on flowers of *Caltha palustris*.

Eristalis temporalis Thompson.

Male, female. Antennæ very dark brownish black; arista slightly plumose basally; facial stripe prominent, together with cheeks shining black; ground color of face black. Pile of face light brownish yellow in color, sparse; on front and vertex similarly colored. Face and front of female unusually broad. Thorax dark shining, greenish or brownish black. Scutellum not quite so dark, brownish, shining. Abdomen greenish or brownish black; second segment with a shining, large, prominent, sharply marked, brownish yellow spot on either side, rather widely separated by opaque black medianly. The posterior marginal bands of the segment unusually prominent, light yellow. Segments three and four shining, save for an opaque, posterior, rarely interrupted band on the third segment and a median anterior "dagger-like" spot on both third and fourth segments. Legs black, moderately shining, bases of hind femora, apices of all the femora, basal half of hind and front tibiæ, greater part of middle tibiæ basally, pale yellowish. Wings hyaline, or very faintly, scarcely perceptibly, infuscated in the middle and anterior half. Length: 10–15 mm.

The above description may be considered typical; description of one or two variations are given below.

With this and the following three species, "our trouble begins." The discovery of certain European species within the confines of North America has not seemed to clarify a situation, already perplexing enough, due to older species being poorly understood and studied from but few specimens. The writer has studied good series of most of the forms and believes he has come to a fairly good understanding of their characters; the obscurity of these, however, renders their description a most difficult matter.

A study of a series of specimens betrays several interesting facts. The females are found to be more difficultly distinguishable and are further found to be more "shining" than the males.

Eristalis temporalis differs from all the others in at least one respect; in both males and females of the typical variety, the light colored spots of the abdomen are about equally prominent.

The males of the typical variety can only be confused with *obscurus* and a variety of *nemorum*. This variety of *nemorum*, as will be further discussed under that species, is a form which lacks the second pair of light spots on the abdomen. Typically this species seems to have light brownish spots on both the second and third segments. From the variation, *temporalis* may be distinguished by the pale yellow color of its pile, the wholly shining thorax, with never a trace of darker spots or bands, and

the *yellow* abdominal spots. The spots of *nemorum* are reddish, the pile and the whole insect has a reddish or fulvous appearance; the thorax is considerably more opaque, with traces of dark spots or vittæ, etc. Occasionally one finds *nemorum* with only deep yellow pile. In *nemorum* there are traces of a median dagger like spot on the third and fourth segments, never so prominent as is usually found in *temporalis*. The males of *rupium* likewise exist in a similar variety to that of *nemorum;* they may be at once separated from *temporalis* by the well defined infuscation of the wings, reddish color, etc.

The females of the typical form, can not be confused with the others; in all the remaining species the females have the light spots of the abdomen obsolescent.

A certain form of female in this group is quite commonly collected, often among *temporalis*, and is usually considered to be a variety of that species. It is, however, very much closer to the females of *obscurus*, and as I shall show below, almost indistinguishable from them. Still the one character which links it with *temporalis*, I believe to be more important than the several by which it resembles the female of *obscurus*. It is a peculiar situation. Specimens of the form are nearly always found among collections of *temporalis*. The true *obscurus*, about the validity of which there can be no doubt, is too poorly known at present, for us to say what species or forms consort with it. The chief difference of the variation lies in the fact that the light spots of the abdomen are entirely obsolescent.

What I consider the females of *obscurus*, have been taken from a large series of that species, associated in the fields with the males, and collected by Professor J. S. Hine in Alaska. These males of *obscurus* seem quite distinct. The variety above mentioned, which I shall call *beta*, n. var. (vide inf.), for it is certainly a variety whatever the species, further departs from temporalis and resembles *obscurus*, in having the pronounced, shining greenish black color of the latter, together with very narrow yellow, posterior bands on the segments. The marginal bands in the former species are much wider. This species has always been considered the exclusive possessor of dagger-like median spots on the third and fourth segments, but traces of such may be found in all degrees, in *obscurus*, and, as already remarked, in *nemorum*. They are frequently absent in these two species; I have never seen them lacking in *temporalis*. The

variety *beta* agrees with *obscurus* in having these spots usually slight. In *temporalis* the wings are substantially hyaline; in all my specimens of *beta* and *obscurus* there is a distinct infuscation in the stigmal area of the wings. In one respect the specimens of the variety differ from *obscurus* and agree with *temporalis;* the latter species has the middle tibiæ yellowish for their basal two-thirds or more, while in the other, never more than the basal half is yellow.

The males of the species differ from the males of *obscurus* in the following respects: in the latter species the abdomen is considerably less shining, the light spots of the second segment in particular, nearly opaque (shining in *temporalis*), and of a pale yellowish white color. The pile of the fourth segment wholly white; usually yellowish in the other species.

Two males that differ in having the femora as well as the tibiæ and tarsi, largely yellowish, I call variety *alpha*. n. var. (vid. inf.). In some intangible way the yellow of the abdominal spots is deeper and more conspicuous. It closely approaches certain European forms, from which it is, however, quite different.

Some sixty or seventy specimens of *temporalis* have been studied from British Columbia, Oregon, California and Wisconsin.

Variety *beta* n. var. All females; type: Banf, Alberta, June 11; paratypes: Stanford U., Calif., June 16, 1910; Walnut Creek, Calif.; Mary's Peak, Oregon (In the author's collection).

Variety *alpha* n. var.; type, a male, Banf, Alberta (J. F.). In the author's collection.

Eristalis rupium Fabr.

Female. Antennæ usually dark brown or red, never black, sometimes rather light reddish; first two joints always shining black; arista plumose on the basal half. Cheeks shining black. Face shining; it and ground color of face vary from a rather light reddish color to black; face somewhat pollinose, pile sparse, yellowish white in color. Pile of front and vertex yellowish to white; blackish about the ocelli. Thorax dark shining brownish black, no darker markings on the disc; scutellum concolorous, pile yellowish. Abdomen shining black; second segment opaque black, the spots always obsolete, metallic, black and shining. Third and fourth segments with opaque bands posteriorly and narrower bands, sometimes lacking, anteriorly; bands of both segments often interrupted. Hind femora, except basally and apically, front and middle tibiæ femora, save on their apices apical half of hind tibiæ, apices of remaining tibiæ and last two joints of all the tarsi, black; otherwise

yellow or reddish. Wings with a dark brown infuscation in the middle and on the anterior half, sharply delimited from the basal half of the wing, although it may be surrounded by lighter infuscation on either side.

Male. The antennæ very dark brown; facial stripe and cheeks very dark brown; facial stripe and cheeks shining black; ground color of face black, plainly apparent beneath the light, irregular pollen and sparse brownish yellow pile; pile on front and vertex fulvous. Thorax wholly dark shining brown, color obscured by dense, reddish or fulvous pile. Scutellum similar in color and pile. Abdomen black, a rather large, shining, strongly reddish spot on either side of the second, and usually a similar, smaller spot on either side of the third segment. Fourth segment wholly black. Opaque bands nearly as in the female. Legs as in the female, except that the hind femora are entirely black, with the exception of the narrow apices. Wings similar. Length: 9–12 mm.

The male of *rupium* has been discussed under *temporalis;* its reddish color, stigmal spot, and spots on (usually) both second and third segments, characterize it; *nemorum* (male) resembles it in reddish coloration, but has the wings practically hyaline. The female of *rupium* is in strong contrast to the male, the former being largely shining black with no reddish spots on the abdomen. It can be confused only with the female of *obscurus*. Long series of *obscurus* show the degree of infuscation of the wings to be quite variable. However, the infuscation of this species will be found to be lighter and not so sharply marked as in the other species. The antennæ of *rupium* are brown to reddish, in the other, black. Further this form has the hind tarsi basally reddish to yellowish; they are black in *obscurus*.

Recorded from British Columbia by Dr. R. C. Osburn. I have additional British Columbian specimens, seven females from Wallface, New York (A. S. Nicolay), one female from Moss Pond, New York (R. C. Shannon), as well as European specimens.

Eristalis obscurus Lw.

Male. Antennæ black. Facial stripe and cheeks shining black; ground color of face black, slightly pollinose, sparsely yellowish white pilose. Thorax dark greenish black; moderately shining. Scutellum brownish; shining. Pile of thorax nearly wholly pale yellowish; abdomen black, with a pale yellowish white spot on either side of second segment; but slightly shining, more so on third and fourth segments. An opaque band on the posterior margin of the segments, often wanting on the fourth; a similar band on the anterior margin, narrower and produced posteriorly to form a kind of median triangle. Pile of anterior half of second segment and posterior part of fourth nearly white, on remainder of abdomen black.

Infuscation of wings never very great, but always present, diffused more or less over the whole basal two-thirds of the wing on the anterior half. Length: 8–13 mm.

Female. More shining. Spots of abdomen always obsolescent. The female might be confused with that of *nemorum*, the differences with which have been considered under that species.

This form, *obscurus*, of which I have studied a large series collected by Professor J. S. Hine in Alaska, is evidently a distinct one. It presents one or two little discrepancies from the original description. The antennæ of the species are described as reddish ferriginous and also the base of the hind femora as yellowish; the types were males. These two characters are applicable also to the females of *rupium*, but not to the males. I find seven or eight specimens of what I have considered *obscurus* with the bases of the hind femora yellowish in a varying degree; the antennæ are black. The antennæ and face of *inornatus* are likewise described as reddish to ferruginous; the type was a single poorly preserved female. May not Loew have had either *rupium* or *nemorum* or some other European species before him when he described *obscurus* and *inornatus?* My specimens of *obscurus*, so called, are a good species and I have called it this for the present. A study of the types will be necessary to clear the matter up.

Some seventy or eighty specimens, from Alaska, taken by Professor Hine, have been studied.

Eristalis nemorum Linne.

Male. First and second joints of antennæ shining black; third joint reddish to dark brown. Facial stripe and cheeks shining black. Ground color of face black, obscured by dense yellow pollen and pile. Thorax dark brownish black, but moderately shining; dull or obscure spots or bands can usually be made on the dorsum. Scutellum lighter, reddish brown. Pile of thorax, thick, short, and strongly reddish or fulvous, occasionally deep yellow. Abdomen black, second segment with a conspicuous, light reddish brown spot on either side; third segment usually with similar though smaller spots. Third and fourth segments shining, with an opaque band both anteriorly and posteriorly, the former often produced posteriorly in the form of a faint median dash. Legs as in the general type. Wings practically hyaline, faintly infuscated on the stigmal area.

Female. Differing considerably from the male; there are usually traces of the abdominal spots remaining on the second segment; dark reddish brown; the infuscation of the wings more noticeable and greater in extent; not so conspicuously reddish brown as in the male; more shining, etc. Length, 10.5–12.5 mm.

Closest to the female of *obscurus* but distinguished by the brownish to slightly reddish antennæ, yellow pile of face and the brownish to fulvous pile of the thorax.

Recorded by Dr. R. C. Osburn from this country, Journal N. Y. Ent. Soc. XXIII, 144. Additional specimens from Portland, Oregon (Binswanger), Teulon, Manitoba (Hunter and Cummins), and Moscow Mts., Idaho (R. C. Shannon).

Eristalis inornatus Lw.

This species has been reported several times since being described, but with very doubtful determination. Certain of these species examined by the writer, have turned out to be *rupium*, *nemorum*, etc. I should not be greatly surprised if *inornatus* represented one of the above species in some of their variations, or sexual forms.

I have seven specimens separated from a series of *obscurus*, and mentioned under that species, all of which agree among themselves in having the base of the hind tibiæ reddish to yellowish, in varying degree, slightly larger in size, etc.; their antennæ black. The species *inornatus* was described from a female, with reddish hind femora basally, but likewise with ferruginous antennæ; the face was said to be longer, the tubercle less prominent, than in *obscurus;* both these species were described by Williston as similar to *E. dimidiatus*. Like *obscurus*, a study of the type is necessary before definite conclusions may be attained. Both this species and *obscurus* were described from the Red River of the North. The length of the former was given as 13 mm.

Recently a species has been described within this group from Colorado, by Mr. E. E. Wehr (Univ. Studies, Vol. XXII, p. 151, 1922). The form, which he called *nitidus*, is of doubtful relationships; from a perusal of the description, as I have not been afforded opportunity to examine a paratype, it would seem probably nothing more than one of the European forms that have confused our American species. The name is preoccupied by Van der Wulp from an East Indian species.

The Obsoletus Group.

(Group description.)

The obsoletus group contains a small number of species, at first sight rather dissimilar, but with more study, appearing somewhat closely related. Of the five species which I have seen and placed within this group, all are of large size, stout and robust build. A brief description of their characters, and the points on which they agree, follows.

Antennæ always broadly oval, but little longer than broad; normal in size; arista bare; bristle of second antennal joint unusually strong and prominent. Eyes unusually hairy for an *Eristalis;* the pile, while extensive, is usually lacking or short, on the lower third. Eyes of female narrow to widely separated. Face very sparsely pilose, and thinly pollinose; facial stripe ill defined, and usually limited to the central knob, or tubercular prominence. Thoracic dorsum opaque, or very feebly shining, practically unicolorous, with usually but faint indications of vittæ or fascia. Scutellum opaque, sometimes polished on the rim. Abdomen short and stout, generally highly shining; frequently unicolorous, sometimes obscurely marked with brown or black; segments with the usual, narrow, posterior, yellow marginal bands, frequently wanting only on the second segment, entirely lacking only in *tenax*. Hind femora usually considerably thickened, rarely slender. Hind tibiæ notably flattened and arcuated, with the lower (outer) surface, densely lined with a row of long, stiff hairs.

The flattening of the tibiæ is found to a slight extent in several groups of the genus, but never to so marked an extent. This is likewise true of the ciliated hind tibiæ. In such species as *obscurus*, *pilosus*, etc., the hind tibiæ are merely sparsely and loosely haired and may then be described as only pilose; in *albifrons*, *pusillus*, etc., a definite row of more loose, quite short bristles or hairs may be found, thus more or less intermediate between the two conditions, but not to be confused with the ciliate tibiæ of the present group. *E. vinetorum*, of the *albifrons* group also has the tibiæ as in this group. Wings usually nearly or entirely hyaline; sometimes with a dark blotch or spot near the middle.

Eristalis tenax, while plainly belonging here, shows several differences. The eyes are banded with two rows of hairs; the abdomen is neither so broad nor so short. *Eristalis mirabilis* while agreeing well with most of the characters above, has the thorax rather strongly banded in some lights. These are, however, rather vague and obscure as compared with members of

the *albifrons* or *scutellaris* groups. Finally, *ruficeps* differs markedly in the type of face, although agreeing well otherwise; in profile it is seen to be considerably swollen, yet evenly rounded with the facial prominence practically absent; very slightly excavated below the antennæ.

KEY TO THE SPECIES OF THE *Obsoleta* GROUP.

1. Face and thorax black.....*pygolampus* Wied.
   Thorax brown to reddish or yellowish, never black.....2
2. Thoracic dorsum entirely yellowish to reddish brown.....3
   Thorax with indistinct transverse fasciæ.....4
3. Pile of thorax light yellow; third joint of antennæ dark brown or black.....*tenax* Linne.
   Pile of thorax reddish; third joint of antennæ light reddish brown.....5
4. An obscure, transverse, black band before the suture; wings with a large brown spot near the middle; pile of front and vertex.....*mirabilis* n. sp.
   No such black band on the thorax; wings only slightly infuscated; pile of front and vertex light.....*obsoleta* Wied.
5. Prominence of face indistinct; face swollen, evenly rounded; hind femora not thickened; all the femora nearly all black.....*ruficeps* Macq.
   Tubercle of face prominent; face not evenly rounded; hind femora considerably thickened, usually reddish.....*obsoleta* Wied.

Eristalis pygolampus Wied.

Male, female. Antennæ dark reddish brown; arista of the same color. Ground color of face black, covered with a scanty, dark brown pollen and a very few moderately long, golden hairs, sometimes whitish. Pile of front more abundant, black at vertex and just above antennæ, yellow between. Facial stripe and cheeks shining black. Thorax opaque, velvet black; in one somewhat teneral specimen, there are very faint fasciæ anteriorly, and posteriorly shining, with a bluish cast. Scutellum deep red, opaque, shining on the rim. Abdomen shining black, more brassy on the third and fourth segments, marked by opaque black as follows: Second segment with a median anterior spot and a posterior marginal band; third segment with a similar, smaller spot and a narrower posterior band. Third and fourth segments with a narrow, posterior, marginal band, widened medianly, of an opaque yellow, pollinose nature. Femora shining black, black haired; hind tibiæ black. Front and middle tibiæ and all the tarsi, light brownish or reddish yellow, yellow haired. Wings nearly hyaline, with a large brownish black spot in the middle. Length, 12–14 mm.

Three specimens. Itaquaquecetuba (F. R. Cole), Brazil; Bartica, British Guiana; Sao Paulo, Brazil.

The single male is slightly teneral; the common, "white pollinose line" of the thorax, mentioned in the original description is obscurely present, but with not a trace of it present in the two females. The yellow of the front, as described, seems normally to extend over only the small, bare, calloused area, present above the antennæ commonly within the genus.

Eristalis tenax Linne.

Male, female. Little need be said of this common and cosmopolitan species, save in a comparative way with the other members of its group. While of the same broad, stout form, its appearance is changed by the more flattened abdomen and more deeply projecting face. The only species of the group with a complete facial stripe and likewise with heavy pruinescence on the face. Antennæ dark brownish black. Cheeks black; facial stripe, shining, very dark brown. Pruinescence of face, pale yellowish brown. Thorax opaque dark brown, sometimes slightly shining; not unicolorous as apparent at first sight; a very obscure, wide, darker stripe, may be seen on either side of the thorax, broken at the suture, apparent in many specimens. Pile very dense, but short, pale brown. Abdomen shining, dark brown, almost black, with a light, oval, yellowish brown spot on either side of the second segment, frequently obsolescent. In a varietal form, the whole basal half of the third segment of the male, is similarly colored, narrowly interrupted medianly with black. In the female it is confined to a slender, transverse, medianly interrupted band, in the middle of the segment. Legs dark brown; basal third of front and hind tibiæ, and larger part of middle tibiæ and first two joints of middle tarsi, pale yellowish; front and hind tarsi, and last three joints of middle tarsi, dark brown. Wings nearly hyaline, sometimes faintly clouded in the middle. Length, 12–15 mm.

A universally common species, yet oftentimes local, due probably to the nature of its breeding places.

Eristalis mirabilis n. sp.

(Plate II, Fig. 11.)

Female. Antennæ dark brownish red. Facial spot shining reddish brown. Cheeks shining black. Ground color face reddish brown. Pruinescence of face brownish yellow; pile whitish. Front dark brown, becoming black at the vertex, opaque except just before the antennæ; pile blackish. Thorax with rather prominent fascia for a member of the group. A band between the humeri, dark brown, opaque; immediately behind, a narrow black band, followed by the narrow, obscure, interrupted white line before the suture. Behind the suture, a wide black band. Remainder of thorax, shining grayish black. Scutellum opaque, light reddish brown, shining on the rim. Pile of thorax and scutellum strongly brownish red. Abdomen shining black, marked by opaque black as follows: a median band on the second segment continuous posteriorly with a marginal band of the same width; third segment with a small median spot and posterior margin with a band; fourth segment with marginal bands, anteriorly and posteriorly. All the femora and hind tibiæ, shining black; anterior and middle tibiæ dark brown; all the tarsi light brownish red. Wings slightly tinged with brown, with a large brownish black spot in the middle. Length 15 mm.

Type, one female, Vista Nieve, Columbia. Nov. 16, 1922. (H. L. Viereck). Type in the collection of C. H. Curran.

In some respects resembling pygolampus, but differing in the color of the face and scutellum, bands of thorax, pile of thorax, etc.

Eristalis obsoletus Wied.

Male, female. Antennæ dark to light reddish brown; facial spot of the same color. Cheeks and ground color of face shining black, the latter sometimes nearly bare, usually obscured by dense, pale pruinescence; pile of face whitish. Pile of face and front very variable. In the males, pile of face rather abundant, golden; of front, above antennæ, yellow, intermixed with black, sometimes wholly black; of vertex golden. In the females, the pile of front and face is very thick, often wholly pale yellow; sometimes very largely black on front and vertex. Thorax very dark, opaque brown, heavily obscured by pile, in some cases bright fulvous, again light brownish yellow. Scutellum opaque, light reddish brown, shining on the rim; pile of the same color. Thorax nearly unicolorous, only the pale interrupted, sutural lines being present. Abdomen shining, dark brownish black, a large light brownish red spot on either side of the second segment; narrow, yellow, posterior marginal bands of segments often unusually prominent. In the male, conspicuous bands of black pile posteriorly, on segments two, three and four, are contrasted with bands of pale yellowish pile, anteriorly; sometimes abdomen wholly yellow pilose. Narrow bands of opaque black, on the posterior margins of the same segments, and a similar, small median spot, on the anterior margins of third and fourth segments. In the female the pile is usually wholly yellow, never with conspicuous bands of black and yellow pile. Light spots of second segment frequently obsolete. Two male specimens are considerably smaller, very dark, with the shining bands of the third and fourth segments very metallic. In the males the femora are wholly shining black, with the exception of the narrow apices; hind tibiæ black, narrowly pale yellowish basally; front and middle tibiæ brown, yellowish basally; tarsi light reddish brown, pile golden. Legs of female shining red, femora rarely black, paler on the tibiæ and tarsi; bases of tibiæ pale yellowish. Hind femora strongly thickened. Wings nearly hyaline, with a small brown spot near the stigma, sharply delimited basally. Length, 10–15 mm.

A very variable species. Nearly thirty specimens, from Guatemala; Chapada, Sao Paulo, Brazil; Yucatan, Mexico; Bartica, British Guiana. Also numerous specimens from San Diego, and Mill Creek Canyon, San Bernardino Co., California. (F. R. Cole).

Eristalis ruficeps Macq.

(Plate II, Fig. 10.)

Female. Head very large; face swollen. Antennæ light brownish red. Face and front very wide, the former light reddish brown; front slightly darker, vertex blackish. Pile of face abundant, pale yellowish brown, darker and more reddish on front and vertex. Cheeks shining black. Facial spot small, prominence practically lacking; face in profile evenly rounded, very slightly retreating below the antennæ. Thorax practically unicolorous, dark opaque brown, obscured by very dense, reddish pile. Scutellum, light brownish yellow, wholly opaque; pile concolorous. Abdomen shining black, with a more or less quadrate, reddish brown spot on either side of the second segment. Second segment with a wide, black, opaque band medianly, and a similar band on the posterior margin. Similar narrow bands, on the anterior and posterior margins of the third and fourth segments. Hind femora slender; all the femora shining black, narrow apices of anterior and middle pairs, yellow. Hind tibiæ black, narrowly yellow basally; all the tarsi and the remaining tibiæ, dark brown, the latter basally yellowish. Length, 18 mm.

One female. Coroico Yungas, Bolivia. April 5, 1899. (Ohio State University Collection.)

The Arbustorum Group.

(Group description.)

A small group; species medium to large in size. Antennæ oval in shape, slightly longer than broad; arista bare to short plumose. Eyes densely and long pilose; rather broadly separated. Facial stripe well developed in some; again obsolescent. Face long pilose, though not especially densely; sparsely to heavily pruinose. Thorax nearly opaque, but feebly shining, occasionally more highly, for a short distance in front of the scutellum; nearly unicolorous, marked by obscure spots or bands. Scutellum dark in color; moderately shining. Abdomen largely black, marked to a greater or less degree with yellowish brown or red, basally; of the usual shape. Hind femora quite slender; hind tibiæ normal, or slightly flattened. Wings hyaline.

A group not very sharply separated from the members of the *dimidiatus* group, yet the latter is rendered much more sharply characterized by their removal. The species, while generally opaque on the dorsum of the thorax, they are somewhat shining at the extreme posterior. The species are slightly longer pilose than usual, but are still much shorter than in the

pilosus group, and should not be confused with them on that account.

I have seen only four species falling here. It is most nearly approached within the *dimidiatus* group, by *nemorum*. Although *assimilis* and *bogotensis* are rather large in size, their tibiæ are quite normal.

KEY TO THE SPECIES OF THE *Arbustorum* GROUP.

1. Face protruding below the eyes for a distance equal to approximately the thickness of the eyes laterally; 12 to 14 mm. in length; unusually robust species..2
   Face protruding below the eyes for considerably less than the thickness of the eyes laterally; 8 to 12 mm. in length. (See Figs. 12 and 14).....3
2. Second and usually third segment of abdomen with a large orange red spot... *assimilis* Macq.
   Spots usually confined to second segment; yellowish brown in color..... *bogotensis* Macq.
3. Basal joint of middle tarsi yellowish except at tip; a transverse basal band of opaque black on fourth segment.....*arbustorum* Linne.
   Basal joint of middle tarsi entirely brown; fourth segment with a minute basal spot of opaque black or entirely shining (Fig. 4).....*brousi* Will.

Eristalis assimilis Macq.

(Plate I, Fig. 7; Plate II, Fig. 12.)

Male. Antennæ black. Facial stripe and cheeks shining black. Face reddish brown in ground color, slightly metallic in appearance; sparsely pollinose; pile pale in color. Pile of front and vertex black. Face rather deeply produced. Thorax opaque greenish black or brown, feebly shining, marked by four very obscure, broken, narrow stripes. Pile pale yellow. Scutellum shining, light yellowish brown. Second segment of abdomen bright reddish orange or fulvous, separated by a wide, opaque black median band, continued anteriorly along the greater part of the margin; the yellow broadly continuous on the third segment, separated medianly by a narrow, opaque black spot on the anterior margin, and a larger, metallic brassy black spot, posteriorly. Fourth segment metallic brassy, a narrow anterior marginal band, opaque black, produced to a small point medianly. Femora dark shining brown or black, apices narrowly yellowish; basal half of anterior and hind tibiæ, and larger part of middle tibiæ, pale yellow; tarsi dark brown or black. Wings hyaline.

Female. Similar to the male. Red of the abdomen confined to the second segment, and very narrowly basally, on the third. Median black band of second segment deeply concave on either side. Length, 14 mm.

Six or eight specimens. Arequipa, Peru. Ohio State University collection.

Eristalis bogotensis Macq.

(Plate II, Fig. 15.)

Male. Face, antennæ, etc., practically the same as in the preceding species. Thorax, opaque greenish black or gray; three slender, obscure,

black stripes, the outer ones broken at the suture. Pile pale brownish yellow. Scutellum shining yellowish brown; subtranslucent. Second segment of the abdomen light brownish yellow on either side, a wide, opaque black stripe medianly, extended anteriorly along the larger part of the anterior margin. Third segment with a small yellow spot in the anterior corners, separated anteriorly by a slender, opaque black band along the anterior margin, produced medianly into a sharp point, and posteriorly by metallic black; a narrow black posterior, marginal band, opaque. Fourth segment wholly metallic black, except for a narrow opaque black band on the anterior margin, produced medianly to a point. Legs nearly as in *assimilis*.

Female. Similar to the male. Yellow of the abdomen confined to two rather small spots on the second segment, surrounded by black on all sides except laterally. Wings nearly hyaline; faintly brownish in the middle. Length, 11–14 mm.

Five specimens. La Paz, Bolivia; Puno, Peru. Previously recorded from Colombia, Bogota, Mexico. Ohio State University collection.

Eristalis arbustorum Linne.

(Plate I, Fig. 5.)

Male. Antennæ dark brown; arista short plumose. Cheeks shining black. Facial stripe a very fine line, usually lacking. Face densely pale yellowish pollinose and pilose. Face much less produced than in the two preceding species. Thorax dark opaque brown, somewhat shining a short space before the scutellum. Scutellum shining dark brown. Pile of thorax, thick, short, brownish yellow. Second segment of abdomen yellow on either side, separated by opaque black medianly, extended anteriorly along the greater part of the margin, sharply cut off posteriorly and not quite reaching the posterior margin. The yellow of the second segment extends broadly on the third, but reaching as much as two-thirds of the length of the segment, only at the extreme edge, sometimes continuous the whole length, and with the narrow yellow posterior margins of the segment. Thus the black of the third segment forms more or less of a large, anteriorly truncate, triangle, the base on the posterior margin, the remaining two sides usually concave. Third segment with a metallic cross band in the middle, very slenderly interrupted medianly. Fourth segment opaque black, a broad, interrupted, metallic cross band in the middle, leaving distinct but narrow, transverse, opaque black bands on the anterior and usually the posterior margins. All the femora black; apices narrowly yellowish. Basal half of front and hind tibiæ, and a somewhat greater extent of middle tibiæ, pale yellowish, otherwise black. Front and hind tarsi, last four joints of middle tarsi, and a slightly variable apical portion of the basal joint, blackish or dark brown. Wings hyaline, often with brown clouds in the middle.

Female. Similar to the male. The yellow spots confined to the second segment of the abdomen and somewhat smaller; the median

black band wider and considerably dilated posteriorly but not reaching the side margins. Third segment with a metallic cross band, narrowly separated medianly, and opaque black bands on both anterior and posterior margins. Fourth segment similar, with similar, slightly narrower, black marginal bands. Fifth segment wholly shining black. Length, 9–12 mm.

An excessively common species, introduced from Europe, that seems to have largely displaced, in most localities, the indigenous *E. brousi*. Specimens from New Jersey, New York, Connecticut and Ohio, etc.

Eristalis brousi Will.

(Plate I, Fig. 4; Plate II, Fig. 14.)

Practically the same as in *arbustorum*, differing as follows: Male. The velvet black of fourth segment restricted to a very small basal median spot, sometimes wanting, and an occasional trace of similar black in front of the yellow hind border.

The black band of the third segment is slightly less wide. Female. Segments three and four are completely shining save for an occasional very small median, basal spot of opaque black, and a slight trace of the same in front of the yellow hind border. Both sexes differ in the nature of the basal joint of the middle tarsi. In *brousi*, the whole joint is dark brown or black, as are the remaining joints, whereas in *arbustorum*, the greater basal part is yellow or light brownish yellow. Length, 9–12 mm.

Specimens from New Jersey, Quebec, Wyoming, etc.

EXPLANATION OF FIGURES.

Plate I.

Drawings of Eristalis. Heavy stippling represents shining black; light stippling shining yellow. The scutellum of the species are somewhat distorted, especially in figures 4, 5, and 6. No pains have been spared to represent the abdomens themselves, and their markings, as accurately as possible. In Fig. 8 light stippling represents gray.

Plate II.

Drawings of Eristalis. Figures 11, 15 and 17 show the thorax; Fig. 18, the hind femora and tibiae; Figs. 19 and 20, view of head from above and in front respect; the remainder are profiles of the head. In Fig. 17 stippling represents aeneus; in 11 and 15 light stippling represents gray and dark stippling shining black.

1. aeneus ♂

2. spectabilis ♀

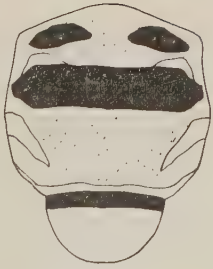
3. agrorum ♂

4. brousi ♂

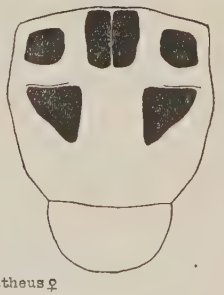
5. arbustorum ♂

6. conicus ♀

7. assimilis ♂

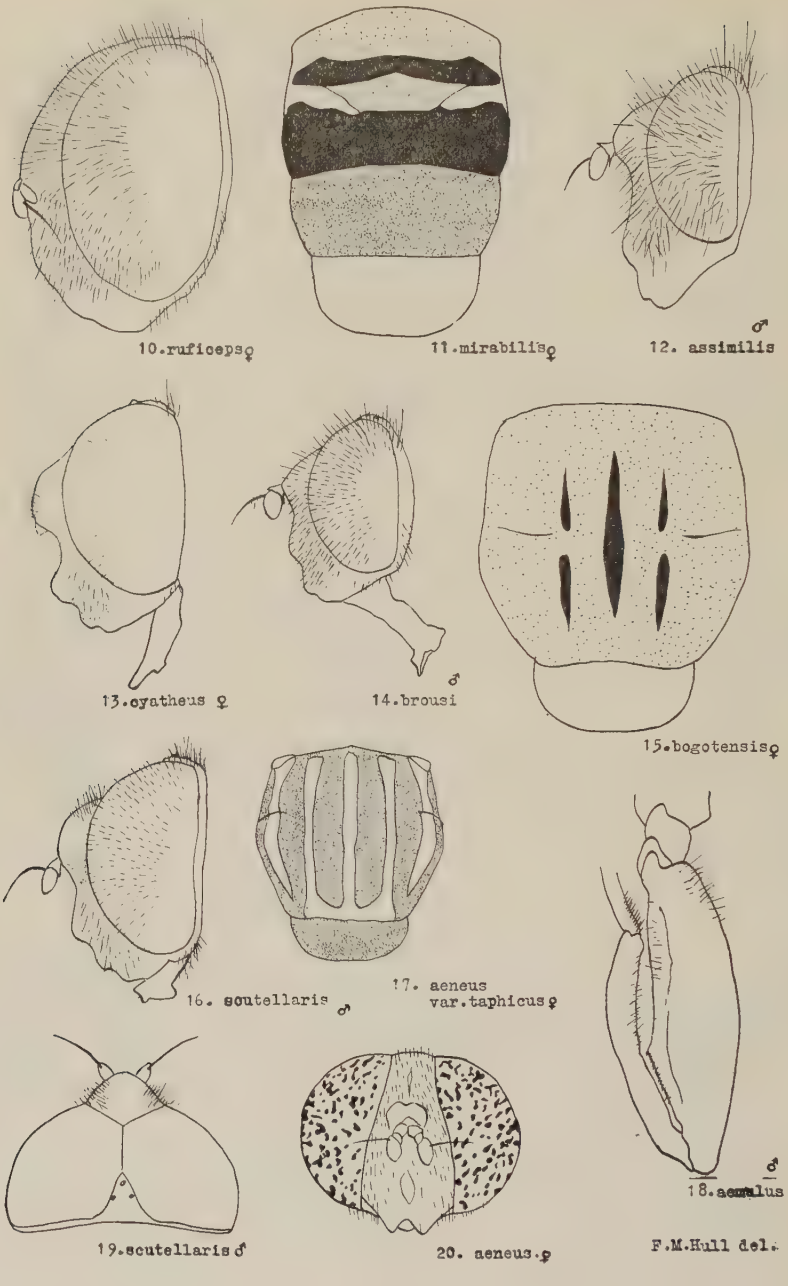


8. precipuus ♀



9. cyatheus ♀

F.M.Hull del.


10.ruficeps♀
11.mirabilis♀
12. assimilis ♂
13.cyatheus ♀
14.brousi ♂
15.bogotensis♀
16. scutellaris ♂
17. aeneus var.taphicus♀
18.aeneus
19.scutellaris♂
20. aeneus.♀
F.M.Hull del.

APHIDS NEW TO OHIO.

C. R. CUTRIGHT
Ohio Agricultural Experiment Station

Since the publication of Guyton's list of Ohio Aphididæ (see *Ohio Journal of Science*, Vol. 24, pp. 1-30, 1924), several species new to Ohio have been collected by the writer. It is thought proper to publish these additions at the present time. The following list is modeled after that of Guyton and contains bibliographical references to the latest and most complete literature dealing with each species. Species not otherwise noted were collected by the writer.

List.

Anoecia corni (Fab.). *Aphis corni* Fab. Hemiptera of Connecticut, p. 258, 1923. On several species of dogwood (*Cornus*) and on roots of orchard grass (*Dactylis glomerata*) and red top (*Agrostis alba*), Wooster, Ohio, spring, summer, autumn, 1924; Columbus, Ohio, October 15, 1923.

Dilachnus pinicola (Kalt.). *Lachnus pinicola* Kalt. *Lachnus abietis* Fitch. Hemiptera of Connecticut, p. 262, 1923. Norway spruce (*Picea excelsa*), Wooster, Ohio, spring, summer, autumn, 1924.

Eulachnus agilis (Kalt.). *Lachnus agilis*, Kalt. *Lachnus rileyi* Wm. Hemiptera of Connecticut, p. 270. Austrian pine (*Pinus Laricio* var. *nigricans*). Wooster, Ohio, September 15, 1923.

Euceraphis betulae (Koch). *Callipterus betulae* Koch. Jr. Ec. Ent., Vol. 10, 1917, p. 425. Red birch (*Betula nigra*), Wooster, Ohio, August 4, 1924.

Rhopalosiphum rubiphilium (Patch). *Aphis rubiphila* Patch. Me. Agri. Exp. Station Bull. 233, p. 269, 1914, on black raspberry (*Rubus occidentalis*), Catawba Island, Ohio, June 12, 1923.

Amphorophora cosmopolitana Mason. *Amphorophora lactucæ* (Kalt.). *Rhopalosiphum lactucæ* (Kalt.). *Aphis lactucæ* Kalt. Maine Agr. Exp. Station Bul. 225, p. 53. On black currant, *Ribes nigrum*, Wooster, Ohio, June 8, 1925.

Amphorophora sensoriata (Mason). Proc. Ent. Soc. of Washington, Vol. XXV, No. 9, p. 188, 1923. Canes of black raspberry (*Rubus occidentalis*), Lucasville, Ohio, July 8, 1924. R. B. Wilcox, Coll.

Capitophorus carduinus (Walk.). *Phorodon carduina* Walk. A Synopsis of the Aphididæ of California, Swain, p. 73, 1919, on Canada thistle (*Cirsium arvense*), Wooster, Ohio, October 13, 1924. Dr. Freda Detmers, Coll.

Capitophorus elægni Del Guercio. Jr. Ec. Ent., Vol. 8, pp. 375-379, 1915, on silverberry (*Elægnus parvifolia*), Wooster, Ohio, November 2, 1922.

Capitophorus. An undetermined species on raspberry (*Rubus occidentalis*), Wooster, Ohio, June, July, August, 1924. R. B. Wilcox, coll. This is one of the species concerned in the transmission of the mosaic disease of raspberry.

Tetraneura graminis Mon. *Tetraneura colophoidea* Howard. *Tetraneura ulmicola* Gill. Hemiptera of Conn., p. 316. Me. Agri. Exp. Station, Bull. 181, on American elm (*Ulmus americana*), Wooster, Ohio, July 15, 1920. P. R. Lowry, coll.

Pemphigus populi-caulis Fitch. Hemiptera of Conn., p. 327, 1923. On cottonwood, *Populus deltoides*, Chillicothe, Ohio, June 20, 1925. A. E. Miller, coll.

Asiphum pseudobyrsa (Walsh). *Byrsocrypta pseudobyrsa* Walsh. Ent. News, v. 25, pp. 269-275, 1914. Hemiptera of Conn., p. 321, 1923. On cottonwood, *Populus deltoides*, Chillicothe, Ohio, June 20, 1925. A. E. Miller, coll.

Neoprociphilus aceris (Monell). *Pemphigus aceris* Monell. Hemiptera of Connecticut, p. 324, 1923. On branches of sugar maple (*Acer saccharum*), Wooster, Ohio, July 9, 1922.

Prociphilus erigeronensis (Thos.). *Trama erigeronensis* Thomas. Me. Agri. Exp. Station Bull. 270, p. 46, 1918. On roots of many Compositæ and other plants. Wooster, Ohio. Throughout the year 1924.

Geoica radicola (Essig). *Trifidaphis radicola* (Essig). *Pemphigus radicola* Essig. U. S. Dept. of Agriculture Bull. 826, p. 79, 1920. Roots of bean (*Phaseoli vulgaris*) and many Compositæ. Throughout the year 1924. Wooster, Ohio.

Chermes strobilobius Kalt. Insects affecting Park and Woodland Trees, p. 187. On larch (*Larix laricina* or *europaea*), Wooster, Ohio, May 10, 1924.

Chermes abietis Linn. Me. Agri. Exp. Station Bull. 173, p. 290. On Norway spruce (*Picea excelsa*). Chagrin Falls, Ohio, September 21, 1924. Dr. H. R. Cooley, coll.

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